NAVAL POSTGRADUATE SCHOOL
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THESIS

STUDY OF INITIAL ENTRY STUDENT ATTRITION
FROM DEFENSE LANGUAGE INSTITUTE
FOREIGN LANGUAGE CENTER

by

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Thesis Advisor: Harold Larson

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13. ABSTRACT (maximum 200 words)

Defense Language Institute Foreign Language Center (DLIFLC) trains students in foreign languages for the Department of Defense. The majority of the students in the basic courses of instruction are enlisted personnel with less than one year of military service. This study analyzes attrition from the basic language courses in an attempt to clarify an observed increase in attrition for fiscal years 1994 to 1996. Students who attrit from languages that are difficult for native English speaking students to learn are sometimes enrolled in the easier basic Spanish course. DLIFLC management was interested in evaluating the effect this influx of previously attritted students had on the attrition from the basic Spanish course. The population of DLIFLC students is described by graphically displaying how attrition is related to several variables which describe the students. Analysis of attrition from four specific languages of varying difficulty and the basic Spanish course was performed using binary tree classification. Results show the variation in attrition for fiscal years 1994 to 1996 was consistent with historical data and students who entered the Spanish course after attritting from another language affected attrition for administrative reasons, but not for academic reasons.

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Submitted in partial fulfillment
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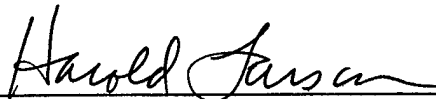
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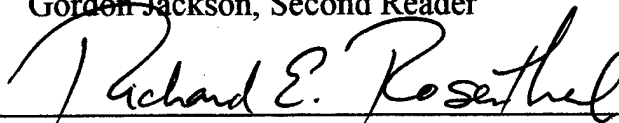September 1997

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ABSTRACT

Defense Language Institute Foreign Language Center (DLIFLC) trains students in foreign languages for the Department of Defense. The majority of the students in the basic courses of instruction are enlisted personnel with less than one year of military service. This study analyzes attrition from the basic language courses in an attempt to clarify an observed increase in attrition for fiscal years 1994 to 1996. Students who attrit from languages that are difficult for native English speaking students to learn are sometimes enrolled in the easier basic Spanish course. DLIFLC management was interested in evaluating the effect this influx of previously attritted students had on the attrition from the basic Spanish course. The population of DLIFLC students is described by graphically displaying how attrition is related to several variables which describe the students. Analysis of attrition from four specific languages of varying difficulty and the basic Spanish course was performed using binary tree classification. Results show the variation in attrition for fiscal years 1994 to 1996 was consistent with historical data and students who entered the Spanish course after attritting from another language affected attrition for administrative reasons, but not for academic reasons.

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EXECUTIVE SUMMARY

The Defense Language Institute Foreign Language Center (DLIFLC) trains, sustains and evaluates language learning for the Department of Defense. The DLIFLC trains students in over twenty-two languages and is located in Monterey, California. The majority of the training performed at DLIFLC is in the basic language courses of instruction. These courses are composed mainly of military students with one or fewer years of military service. Attrition from these courses occurs when a student fails to complete a course of instruction for either academic or administrative reasons. Administrative reasons include, but are not limited to, lack of security clearance, physical fitness failure, needs of the service, etc. Fiscal year 1994, 1995 and 1996 statistics indicated a steady rise in overall (both academic and administrative) attrition of 22.8, 28.4, and 36.5 percent respectively, for initial entry military students from these courses. This issue required clarification and analysis. Another issue which was of interest to DLIFLC management was to analyze the effect of relanguaging of students into the basic Spanish course of instruction. Relanguaging a student occurs when a student fails to complete an initial course of instruction and is placed in another language to study. Relanguaging can be done for either academic or administrative reasons. Since Spanish is one of the easier languages for a native English speaking student to learn, many students get relanguaged into the Spanish course and DLIFLC management was interested in what effect this influx of previously attritted students had on Spanish attrition rates.

This paper first uses descriptive statistics to better understand the population of students who graduated or were scheduled to graduate from DLIFLC during fiscal years 1990 to 1996. Graphs of academic, administrative and overall attrition versus each of the variables are presented to show how attrition varies with each of the variables. The variables that were used were: service, unit, language category, Defense Language Aptitude Battery (DLAB) score, Armed Forces Qualification Test (AFQT) score, Armed Services Vocational Aptitude Battery (ASVAB) subtest scores, education level, input category, age, marital status, gender, race and self-evaluated motivation. The unit is the specific company to which the Army assigned a student during the training. The DLAB is

a test administered during the recruiting process; this test has been generally correlated to a student's success at language learning. The AFQT and ASVAB are also tests administered during the recruiting process. The input category is how a student entered that particular course, the majority of the students are initial inputs who have not attempted that language or another language, some of the students are recycled (i.e., began an initial course of instruction and for either academic or administrative reasons fell behind, then began a later class in the same language), and a lesser number of students begin the course as a relanguaged input. Self-evaluated motivation is determined from the student's response to a statement on an initial entry form at DLIFLC. This statement includes both whether the language he/she is studying is his/her first, second or third choice and statements of how motivated he/she is to language training. This statement is ambiguous but has been correlated to language learning in past studies.

The binary tree classification method is used to determine which of the independent variables are most important in classifying a student as a graduate, an academic attrit or an administrative attrit. This method is used for analysis of fiscal years 1994 to 1996 for the basic Spanish, German, Russian and Arabic courses. These languages were chosen based on the varying difficulty of these languages and the number of students in these languages over the fiscal years of interest. The binary tree classification method is also used for the analysis of attrition of the different student input categories (regular, recycled, and relanguaged) for the basic Spanish course over the same fiscal years.

The study found that the increase in attrition rate over fiscal years 1994 to 1996 was comparable to historic data. When fiscal years 1990 to 1996 were considered, the rates of attrition were at a peak in 1991 and decreased through 1993 and 1994. The attrition rate then increased from fiscal year 1994 to 1996. The overall attrition rate over the seven fiscal years was 30.8 percent, which is comparable with the observed attrition rates for 1994 to 1996. From a historical perspective, a 1974 Army Linguist Personnel Study found the overall attrition at that time of 28.7 percent, which is also comparable with the observed rates of attrition for 1994 to 1996.

The score on the DLAB was the best predictor of academic attrition for this study. The lower the student's DLAB score, the more likely that student would attrit from the course of study. This result agrees with prior studies on DLIFLC attrition.

This study also showed that there was a difference between the services and within the Army units in predicting both academic and administrative attrition. This difference may be due to the difference in assignment of students to their language and when that assignment was made. For example, Navy students were not assigned their course of study until after arrival at DLIFLC and an initial interview. Other services assigned students to their language during the recruiting process. The Air Force has recently developed a program to try to reduce their attrition by instituting an indoctrination course for language learning prior to a student beginning his/her course of study.

Students who were able to complete college or obtain an advanced degree were less likely to administratively attrit in the more difficult languages of Russian and Arabic. This may show that a student who has shown success at completing a program in the past may have more success at completing a course in language training.

In reference to the issue of relanguaging and recycling students; for all languages over the seven fiscal years, a relanguaged student and a regular input student displayed virtually equal attrition rates. A student who was recycled displayed a much lower academic attrition rate (11 percent versus 18 percent for a regular input) and a much higher administrative attrition rate (20 percent versus 13 percent for a regular input).

For the Spanish course, the number of inputs who were relanguaged into Spanish was greater than the other languages; however, the input category was not a predictor of academic attrition. An Air Force or Navy student who was a recycled input in the Spanish course administratively attritted at a much lower rate than a student who was recycled from the Army or the Marine Corps. This may show that the Navy and Air Force looked at other factors that could cause the student to have problems prior to making the decision to recycle the student in the Spanish course.

I. INTRODUCTION

The Defense Language Institute Foreign Language Center (DLIFLC) trains thousands of students in over 22 languages for service in the area of military intelligence. The majority of DLIFLC students are individuals in their initial military assignment. The overall attrition rates for these individuals in the basic course of language instruction for fiscal years 1994 to 1996 were 22.8, 28.4, and 36.5 percent, respectively. This steady rise in attrition requires analysis to clarify possible reasons for this increasing rate.

A. BACKGROUND

Under the guidelines of the Defense Foreign Language Program, DLIFLC's mission is to train, sustain and evaluate foreign language skills. DLIFLC, located in Monterey, California, is tasked to provide our military forces the foreign language skills to support our national interests worldwide.

Languages taught at DLIFLC are divided into four categories depending on the level of difficulty of training native English speaking students. Category I languages are the Romance languages with the initial length of training at DLIFLC of 25 weeks. German is the only Category II language currently taught at DLIFLC, with initial training of 34 weeks. Slavic and Southeast Asian languages are Category III languages with initial training of 47 weeks. Category IV languages are Arabic, Chinese, Korean, and Japanese, with initial training of 63 weeks.

As a prerequisite for language training, a student's aptitude for learning a language is measured by the Defense Language Aptitude Battery (DLAB). The DLAB is a DoD-wide exam that has been generally correlated to a student's success at DLIFLC. Each language category has a minimum DLAB score as an initial entry requirement.

The Defense Language Proficiency Test (DLPT) is used as the standard for successful completion of the initial course of language instruction. Table 1.1 displays the language proficiency standards as determined by the Federal Interagency Language

Roundtable. The scale goes from 0 to 5, with 5 representing an educated native speaker. These levels are used as standards in listening, reading, speaking and writing the language of interest. The current minimum level of language proficiency for military linguists is a level 2 in the areas of listening, reading, and speaking. Writing is not a required skill for these linguists.

Department of Defense Language Proficiency Standards

Level	Functions/Tasks	Context/Topics	Accuracy
Advanced 3	Support Opinions, Hypothesize, Explain, Deal with unfamiliar topics	Practical, Abstract, Special interests	Errors virtually never interfere with understanding and rarely disturb the native speaker
Intermediate 2	Narrate, Describe, Give directions	Concrete, Real-World, Factual	Intelligible to natives not used to dealing with non-native speaker
Basic 1	Question and Answer, Create with the language	Everyday Survival	Intelligible with effort or practice by native listener
0	Memorized	Random	Unintelligible

Table 1. 1 Language proficiency standards. Associates the level of proficiency score with the attributes required for that level.[1]

1.   Potential Student Dispositions and Perspectives

The final disposition of a student at DLIFLC may involve one or more of several events and outcomes, for example:

- Uninterrupted progress through the initially assigned course to successful completion of the DLPT at the end of the course.

- Successful completion of the original course but not "on time," due to being recycled to a later class, for either academic reasons (i.e., could not keep up at first) or administrative ones (e.g., family emergency).

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[1] From DLIFLC command briefing slides.

- Successful completion of a course in a different language, to which the student was transferred (relanguaged) for either academic reasons (i.e., could not successfully complete the original language) or administrative reasons (e.g., needs of the service).

- Failure to complete the course, whether in the original language or a subsequently assigned language, for either academic reasons or administrative reasons (e.g., discharge, security clearance problems, etc.).

Attrition at DLIFLC has been of interest for some time. However, as is implied by the previous paragraph, it is important to realize that "attrition" can be defined in various ways, depending on the context and perspective of the interested party. For example, from a DoD force-management perspective, anyone who enters the pipeline as a recruit programmed as a future linguist but does not successfully complete an initial course of instruction at DLIFLC and graduate from the follow-on, technical-training school is an attrition statistic. From a DLIFLC language program perspective, a student who is originally assigned to Korean, but who completes the course in Spanish instead is an attrit from the Korean course. Viewed from a service perspective, a sailor who is sent to DLIFLC for language study but who does not complete a language is an attrit. From a service language program perspective, an airman assigned to Arabic who emerges as a French linguist is an attrit to the Arabic pipeline – but not to the service's linguist pool overall.

2.   DLIFLC Training Goal

The training goal of DLIFLC is to "Meet the expanding language requirements of DoD and other government agencies by providing effective language training with 80 percent of graduates in all basic courses meeting Level 2 in Listening, Reading, and Speaking."[2] From the DLIFLC perspective, this goal has been interpreted to apply only to those students who take the DLPT at the end of the course. This 80 percent DLPT success does not imply 20 percent attrition since it does not take into account those

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[2] DLIFLC World Wide Web (WWW) page.

students who were dropped from the course due to academic or administrative reasons prior to attempting the DLPT at the end of the course. Therefore, the goal does not imply that 80 percent of those students who initially start the course complete it. Due to the interpretation of this goal, it does not establish the standard to which attrition should be compared.

B.   THE PROBLEM

The overall attrition rates of 22.8, 28.4, and 36.5 percent for individuals with less than one year of service for fiscal years 1994, 1995 and 1996 are from the DLIFLC language program perspective. These are individuals who were assigned to language training, but for some reason, either academic or administrative, did not successfully complete that training in that specific language. Figure 1.1 displays the total, academic and administrative attrition in percent for fiscal years 1994 through 1996. DLIFLC management is mainly concerned with evaluating the academic attrition since it has little or no influence on administrative attrition. Figure 1.1 shows the administrative attrition was almost constant over these three fiscal years and the academic attrition went from 9.8 to 14.7 to 21.9 percent for fiscal years 1994 to 1996.
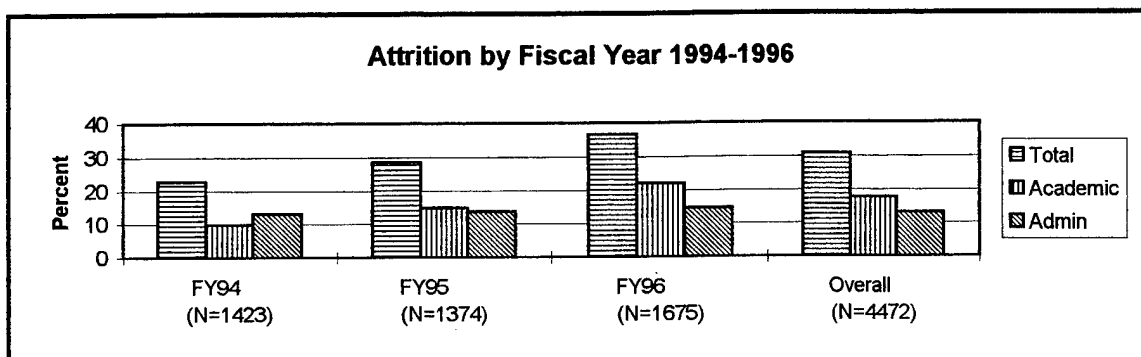

Attrition by Fiscal Year 1994-1996

Figure 1. 1 Attrition by Fiscal Year 1994-1996.

Individuals who do not successfully complete language training are costly to DLIFLC as well as to their respective services. The cost of not completing the language is two-fold, not only for the time and effort trying to train the individuals in a language, but also for the opportunity cost of the time the individual could have spent being more

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gainfully employed in his/her respective service. Identification of the risk factors and how they could be corrected prior to an individual's failing to complete the course of instruction would be beneficial. This study will define the problem and attempt to point out the intricate relationships among the variables using data from fiscal years 1990 to 1996. To evaluate the trend indicated by the steady rise in attrition of individuals with less than one year of service for fiscal years 1994 to 1996, a language from each of the four language categories is evaluated for both academic and administrative attrition. The languages used for this study are: Category I - Spanish, Category II - German, Category III - Russian and Category IV - Arabic. Additionally, since Spanish is one of the less difficult languages, many students who fail to succeed in other more difficult languages are relanguaged into the Spanish course. DLIFLC management is interested in determining the effect that this relanguaging of students into the Spanish program has on both academic and administrative attrition from the Spanish program.

C.   ORGANIZATION OF THESIS

Chapter II contains a review of the literature on attrition from DLIFLC. Chapter III is a description of the population, data and variables considered. Chapter IV is a description of the method used to analyze the data. Chapter V contains the results of the analysis. Chapter VI contains a discussion and conclusions based on the results. The Appendix presents relationships of each of the variables used for this study.

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II. LITERATURE SEARCH

The issue of attrition from DLIFLC's initial course of language instruction has been analyzed in several other studies. However, a study dedicated to attrition only has not been accomplished since 1974 in the Army Linguist Personnel Study (ALPS). ALPS defined attrition as those students who failed to graduate and found the overall enlisted attrition rate from all causes to be 28.7 percent at that time.

A. LANGUAGE SKILL CHANGE PROJECT

The Language Skill Change Project (LSCP) was conducted by the Research and Analysis Division of DLIFLC. The LSCP was a longitudinal study which began in 1987 and tracked 1,903 Army students from their initial training through their initial tour of duty. The objectives of the study included tracking changes in language proficiency over time, identifying factors related to changes in proficiency, and understanding predictors of language learning at DLIFLC. The study concentrated on one language from each of the four categories: Spanish, German, Russian and Korean. The LSCP used several additional tests, that are not normally administered, to better measure factors such as motivation and attitude, ability, and learning strategies. (O'Mara, et al., 1994)

1. The Prediction of Language Learning Success at DLIFLC

LSCP Report II, titled *The Prediction of Language Learning Success at DLIFLC*, considered factors related to success at DLIFLC. The factors considered in this study were demographic variables, ability, personality/cognitive style, attitudinal/motivational variables, language learning experience and learning strategies. The results of the study, which applied to attrition, found that language aptitude (as measured by the DLAB) was more important than general ability (measured by the ASVAB General Technical score) with regard to predicting attrition. This result was especially significant for the more difficult languages of Russian and Korean. The demographics (sex, level of education and

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age) were significant predictors of success in all languages with the exception of Spanish. Also, Spanish was the only language where lack of prior training in the language was a significant predictor of attrition. (O'Mara, et al., 1994)

2. Training Approaches for Reducing Student Attrition from Foreign Language Training

Report III of the LSCP, titled *Training Approaches for Reducing Student Attrition From Foreign Language Training*, used the data gathered from the LSCP to evaluate academic attrition based on potentially modifiable abilities and attributes. The abilities and attributes that were considered included: knowledge of grammar, verbal memory skills, motivation and DLAB score. Of the factors under consideration, knowledge of grammar was found to have the largest correlation (in magnitude), although negative, to academic attrition. The study also confirmed the general trend that students with higher DLAB scores performed better and were less likely to attrit. Additionally, the study found that students with a DLAB score of less than 100 were more likely to attrit, in general. This relationship was dependent upon other extenuating factors such as the extent of the individual's military experience and the category of the language studied. (O'Mara, 1994)

B. OTHER DLIFLC STUDIES

In October 1993, the Research and Analysis Division of DLIFLC published a study titled *Relationships of Language Aptitude and Age to DLPT Results among Senior Officer Students in DLIFLC Basic Language Courses*. This study found that advanced age was not a factor in the ability of senior officers (O5 and O6) to learn a language. However, the level of language aptitude, as measured by the DLAB score, was found to be a significant factor. (Shaw, et al., 1993)

In November 1994, the Research and Analysis Division of DLIFLC published a report titled *Language Choice and Performance*. The purpose of the report was to investigate whether the level of proficiency attained by students in the Basic Courses at the DLIFLC is in part a function of whether the language to which they are assigned is one

that they would elect to study if they were given a choice. The factor of motivation is difficult to measure, since it is based solely on an individual's self-analysis. The results found little or no basis for believing that language choice as measured by this study makes a difference in attrition from the basic course of instruction. (Jackson, et al., 1994)

C.   ARMSTRONG LABORATORY STUDY OF DLIFLC ATTRITION

Armstrong Laboratory performed a study titled *Cryptologic Linguist Career Field: Accession Characteristics and Selection Test Validity*. The purpose of the study was to evaluate changes in accession characteristics and quality of Air Force accessions from 1990 to 1996 and to validate the selection tests (DLAB and the general classification composite of the ASVAB). This study used the DLIFLC definition of attrition; students who failed to successfully complete a basic language course, for either academic or administrative reasons, and were not recycled in that course, counted as an attrition statistic. The Air Force and the Army had comparable attrition rates, but the Navy had lower attrition rates. The Navy's lower attrition rates were for both academic and administrative reasons and for all language categories. The study found that the accession quality (measured by ASVAB general classification, DLAB, and mean Armed Forces Qualifying Test) for the Air Force has remained constant over the past six years. Additionally, the study found the selection tests of DLAB and general ASVAB were valid for predicting success in language training. (Skinner, J., 1995)

D.   EFFECT OF GENDER ON DLIFLC ATTRITION

In September 1996, George Arthur, a Naval Postgraduate School, Operations Analysis student, completed a thesis titled *The Effect of Gender on Attrition at the Defense Language Institute Foreign Language Center*. The issue studied was that approximately 34 percent of female students suffered attrition in FY95, as opposed to 27 percent attrition for male students. The question posed was whether this disparity in attrition was a case of gender bias at DLIFLC. The results showed that gender alone is

not able to predict attrition in any service. However, there were significant main effects for gender when the model was run for the Air Force only. Additional investigation found that the Air Force had a higher percentage of female students than other services, 35 percent compared to 24 percent for other services. Also, the Air Force assigned 56 percent of the female students to Category IV languages (compared with 45 percent for other services). Finally, 95 percent of the Air Force female students were paygrade E-3 and below compared to 73 percent for other services. It was concluded that the combination of these factors, (higher female to male ratio, higher percentage in the most difficult language category and higher percentage of E-3 and below students) may have contributed to the result that gender was a significant factor for the Air Force-only model. In conclusion, the study found no evidence that gender bias was occurring at DLIFLC. (Arthur, G., 1996)

III. THE DATA

Personal and professional statistics of students who have attended DLIFLC are maintained in a database shared with the Defense Manpower Data Center (DMDC). The data for this study were obtained from this database with the generous assistance of Mr. Victor Shaw.

A.   THE POPULATION

The majority of the training at DLIFLC is conducted in the basic courses of language instruction. The basic courses are mainly composed of enlisted military students who have one or fewer years of military service. The attributes corresponding to the majority of the students were used to select records from the shared DLIFLC-DMDC database. The factors used to extract the appropriate records were the language program (the basic course of instruction), the number of years of military service (0 or 1 year prior to entering DLIFLC) and rank (enlisted students only). The fiscal year of the class graduating was also used to select students who graduated or were scheduled to graduate in fiscal year 1990 to 1996. These factors were used to select the 12,287 records for this study.

The DLIFLC-DMDC database contains a record for each time an individual begins a new course of instruction. If an airman starts a course in Korean in FY91 and graduates from that course as scheduled in FY92, there is one record in the database for that airman. Figure 3.1 graphically displays this airman in example 1, and the airman would count as a graduate for FY92. However, if a sailor begins a course in Russian in FY91 and falls behind his class and the decision is made to drop him back to a later Russian class, he appears in the database twice. The first entry in the database would reflect the sailor beginning the Russian course in FY91, and would provide a reason for not completing the originally scheduled course. The second entry would indicate he entered the class as a recycle (since he remained in the Russian track) and provide his final disposition for the

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course (i.e., graduate or attrit, assume graduate for this example). The second entry in the database also provides the information that he entered the later Russian course as a recycle in FY92 and subsequently graduated in FY93. This sailor's track is graphically displayed as example 2 in Figure 3.1, with the lower horizontal line depicting the course that started in FY92 and ended in FY93. Of particular note is that although the sailor did not complete the original Russian course, he is not counted as an attrition statistic since he remained in the Russian track. He does count as a graduate from the Russian course in FY93.

There are scenarios where an individual can count as more than one attrition statistic. Example 3 in Figure 3.1 shows a soldier who begins a course in Chinese in FY91 and after four months of Chinese training, the Army decides they need a Croatian linguist instead, so the student is dropped from the Chinese course and starts the Croatian course in FY91. Then after five months of Croatian, the student falls behind and is recycled to a later Croatian class in FY92. Finally, it is determined the soldier falls further behind and he is dropped from the course and DLIFLC. This soldier would count as two attrition statistics, an attrition for administrative reasons for the Chinese course for FY92 (when the original Chinese course was scheduled to graduate) and an academic attrition for the Croatian course in FY93.
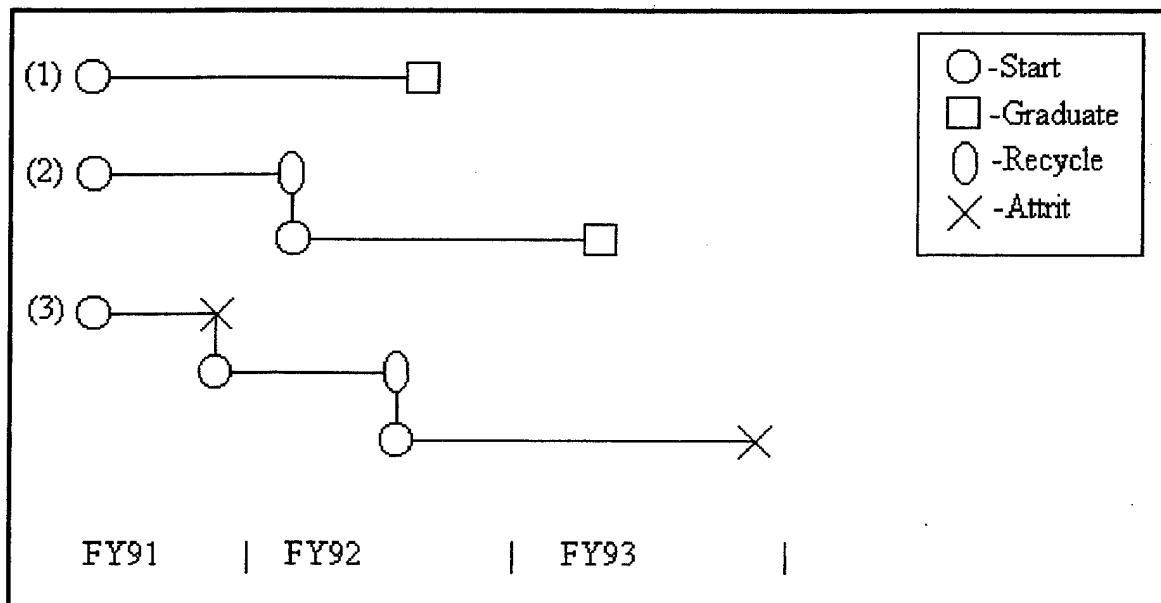

Figure 3. 1 Graphical display of potential student paths.

There are also cases where a student enters the basic course of language instruction and it is determined that that student has enough of the basic skills that he or she is able to move ahead to another basic course which began earlier, thus skipping the early parts of the course. This situation occurred 41 times over fiscal years 1990 to 1996.

As described above, although this study began with 12,287 records, this did not represent 12,287 individuals, since many of the records represented the same individual beginning different classes in the same language and/or another language (examples 2 and 3 in Figure 3.1). To determine attrition statistics in accordance with the methods of DLIFLC, the records where the student disposition denotes a recycle within the same language were removed. Therefore, in Figure 3.1, the top record of example 2 and the middle record of example 3 would be removed from the database. After all of the records with a disposition of recycle were removed from the database, there were 11,139 records remaining for analysis.

Comparison of attrition between different groups can be done in many ways, since these groups can exhibit quite disparate attributes. For example, if the Air Force is trying to compare their attrition statistics to the Marine Corps' statistics, they cannot consider only the final numbers of 32 percent overall attrition for the Air Force and 24 percent overall attrition for the Marine Corps, since many other factors must be taken into account. These other factors include, but are not limited to: the difference in requirements for linguists in each of the language categories, the difference in education level of their students, the difference in demographic factors such as age, marital status and gender, the difference in the student's ability to learn languages, and the difference in student's motivation toward learning that specific language. Unless these other factors and how they might affect attrition are considered, the comparison of the bottom-line attrition numbers is like comparing apples to oranges. Accordingly, a detailed look at how these various factors affect attrition is presented in this section. For the reader who is interested in how these factors vary among the services and among the language categories, graphs of these statistics are contained in the Appendix.

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1. Branch of Service

The distribution of attrition by service is displayed in Figure 3.2. The percentage of academic and administrative attrition as well as the total attrition for each of the services is presented. The number of people in each service in the basic course of language instruction with one or fewer years of military service for fiscal years 1990 to 1996 is displayed below the service label. Also, on the far right, the attrition percentages for all services combined are displayed for comparison of each particular service to the overall average. All of the graphs in this study will contain both the number in a particular group and the overall average. If the overall total number is not equal to 11,139 (the number of records for this study), then there were some records that did not contain the information required for that graph. Figure 3.2 shows the Army and the Air Force with the highest total attrition and academic attrition for the fiscal years 1990 to 1996. The Navy is the only service that had lower academic attrition than administrative attrition. Also the Navy had the highest administrative attrition, but the lowest academic attrition compared to the other services.
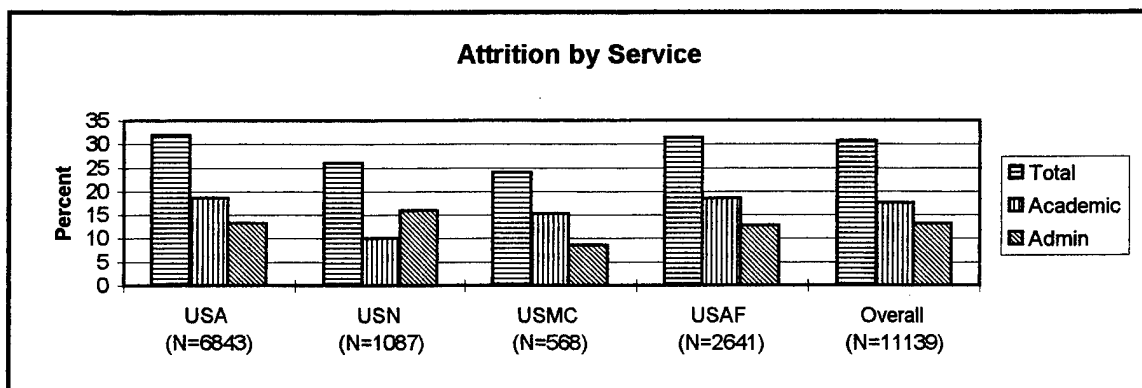
Figure 3. 2 Attrition by Service.

The Army divides their students into units or companies to manage the number of students at DLIFLC. Students are assigned to companies based on two criteria; the first criteria is whether the student has been assigned a military occupational specialty (MOS) or not, and the second criteria is which language the student is assigned to study. Delta and Echo companies are for students who have been assigned an MOS. There are fewer numbers of students in Delta and Echo companies because it is not common for soldiers

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with one or less years of military service to be assigned an MOS. The second criteria, which language the student will study, then determines if the student is placed in Delta or Echo company. The majority of the students in Delta and Echo companies are more senior students attending advanced training at DLIFLC. Alpha, Bravo, Charlie, Foxtrot and Golf companies are for students who have not been assigned an MOS. The students in these companies are also assigned to that specific company based on the specific language they are assigned to study. The attrition by unit is displayed in Figure 3.3. Echo Company had very few soldiers assigned to it, the other companies were roughly equivalent in size. Bravo Company had the lowest academic attrition (disregarding Echo Company) and Charlie Company had the highest academic attrition. Golf Company had the lowest administrative attrition.
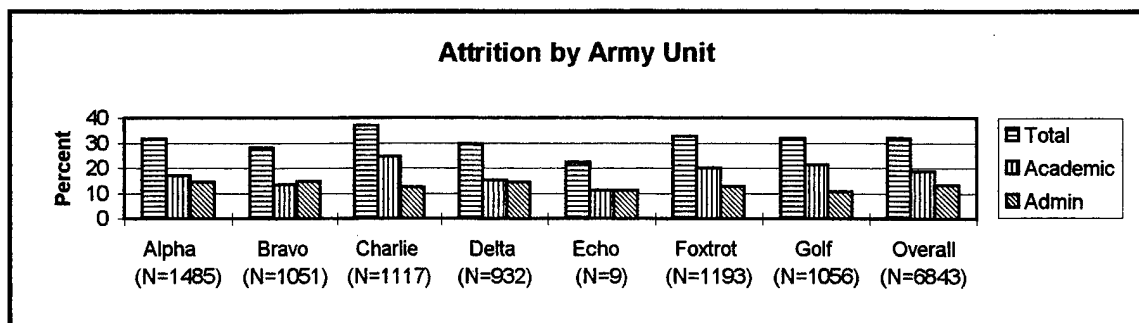
Figure 3. 3 Attrition by Army Unit.

2.   Language Category

As described in the introduction, the languages taught at DLIFLC are divided into four categories depending upon the relative difficulty for a native English speaking student to learn that language. The language categories increase in difficulty from Category I (for example Spanish) to Category IV (for example Arabic). The attrition by language category for fiscal years 1990 to 1996 is displayed in Figure 3.4. The majority of the students were in Category III or Category IV languages (4,530 and 4,169 respectively) and the fewest number of students were in German (the only Category II language currently taught at DLIFLC). Students in Category I languages had the lowest rates of academic, administrative and total attrition and students in Category II and III had the

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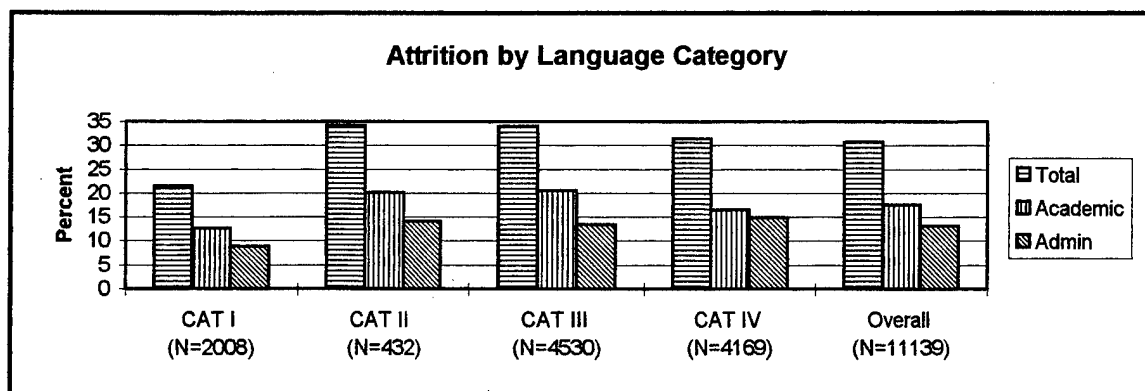highest rates of attrition. The administrative attrition was about equal for Categories II, III and IV.

Figure 3. 4 Attrition by Language Category.

3.   Defense Language Aptitude Battery

The DLAB is a test that is given to an individual during the recruiting process; this test has found to correlate positively with student success in language learning. DLIFLC has established minimum DLAB scores as entrance requirements for each of the language categories. These entrance requirements are: Category I - 85, Category II - 90, Category III - 95, and Category IV - 100. The services also use the DLAB score to assign students to languages where the student would most probably succeed.

The distribution of the individual DLAB scores was used to determine the best breaks for dividing the students into four approximately equal groups. These cutoff scores are the quartiles. The ranges determined by the quartile scores are: first quartile, 0-99; second quartile, 100-107; third quartile, 108-117; and fourth quartile, 118-161. The percentage of attrition by DLAB quartile is displayed in Figure 3.5. As expected, the percentage of academic attrition decreased as the quartile levels increased. The administrative attrition was just about constant over the four quartiles; this result was also expected since administrative attrition is more a random event and therefore should be about equally distributed across the four quartiles. The fourth quartile is the only quartile where academic attrition was lower than administrative attrition.
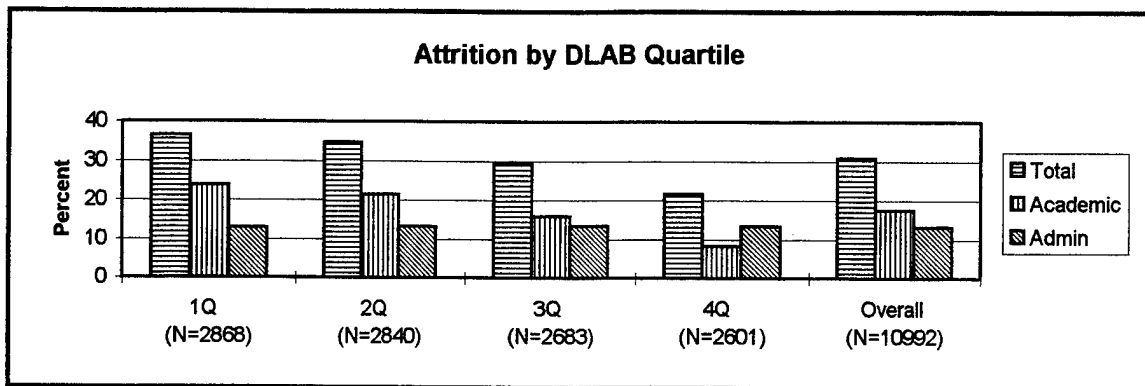
Figure 3. 5 Attrition by DLAB Quartile.

4. Armed Forces Qualification Test

The AFQT is also administered during the recruiting process. The score ranges from 1 to 99; these scores have been divided into Mental Categories as shown in Table 3.1. The majority of the students assigned to DLIFLC are in the upper three AFQT mental categories and the distribution of students in these mental categories is not very descriptive of the population, therefore the AFQT scores were divided by their quartiles, as described above in the DLAB section.

Mental Category	AFQT Score range
Category V	1-9
Category IV C	10-15
Category IV B	16-20
Category IV A	21-30
Category III B	31-49
Category III A	50-64
Category II	65-92
Category I	93-99

Table 3. 1 Definition of Mental Category by AFQT Score.

Figure 3.6 shows attrition by AFQT quartile. The ranges of the AFQT quartiles were: first quartile, 1-78; second quartile, 79-88; third quartile, 89-94; and fourth quartile, 95-99. Both academic and administrative attrition decreased as the AFQT quartile increased; therefore, AFQT scores could also be a predictor of attrition at DLIFLC.
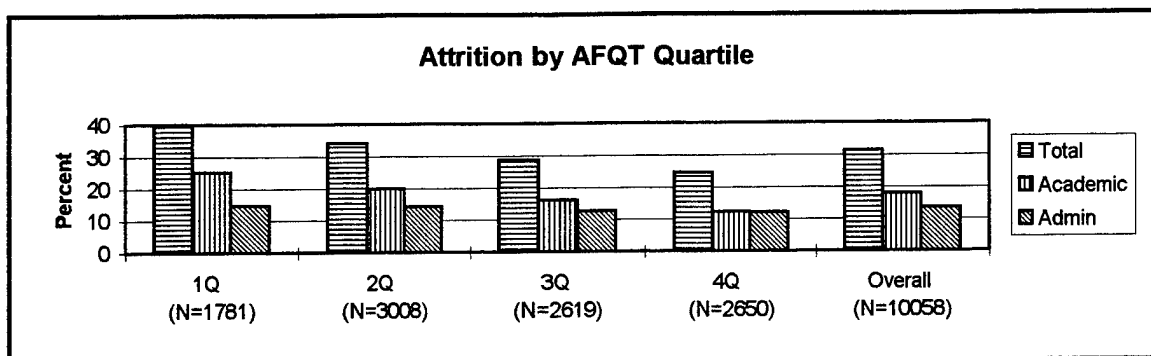
Attrition by AFQT Quartile

| | 1Q (N=1781) | 2Q (N=3008) | 3Q (N=2619) | 4Q (N=2650) | Overall (N=10058) |

Legend: Total, Academic, Admin

Figure 3. 6 Attrition by AFQT Quartile.

5.   Armed Services Vocational Aptitude Battery

The Armed Services Vocational Aptitude Battery (ASVAB) consists of ten different subtests and is also administered in the recruitment process. These subtests are: General Science, Arithmetic Reasoning, Word Knowledge, Paragraph Comprehension, Numerical Operations, Coding Speed, Auto and Shop Information, Mathematics Knowledge, Mechanical Comprehension and Electronics Information. Each of the subtests was examined to determine if it could possibly predict academic or administrative attrition. There were four subtests that displayed a trend that resulted in approximately a 10 percent reduction in academic attrition from the first quartile to the fourth quartile. These subtests were Arithmetic Reasoning, Word Knowledge, Coding Speed and Mathematics Knowledge. Graphs of the other subtests are presented in the Appendix.

Figure 3.7 displays the attrition by arithmetic reasoning subtest of the ASVAB. The ranges determined by the quartiles are: first quartile 35-59, second quartile 60-62, third quartile 63-65 and fourth quartile 66-96. Note that administrative attrition is just about constant across the four arithmetic reasoning quartiles.
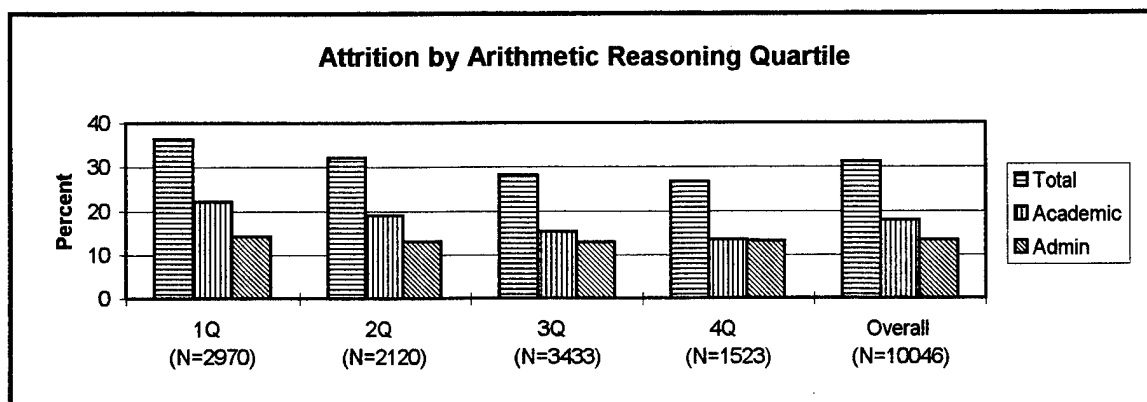
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Figure 3. 7 Attrition by arithmetic reasoning quartile.

The ranges determined by the quartiles for the word knowledge subtest are: first quartile 1-57, second quartile 58-59, third quartile 60 and fourth quartile 61-62. The attrition by word knowledge quartile is displayed in Figure 3.8.
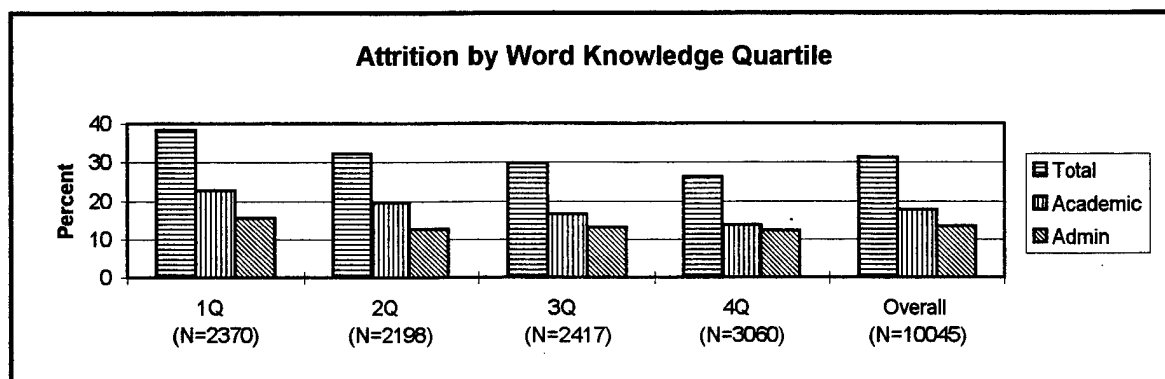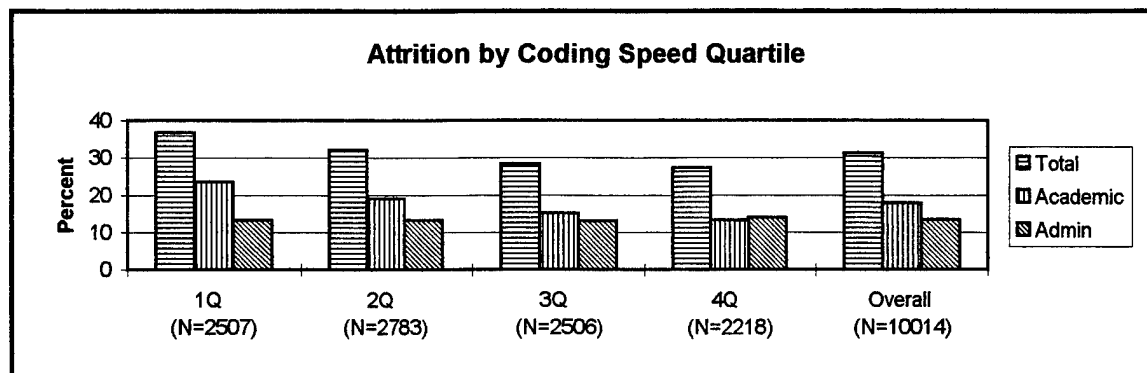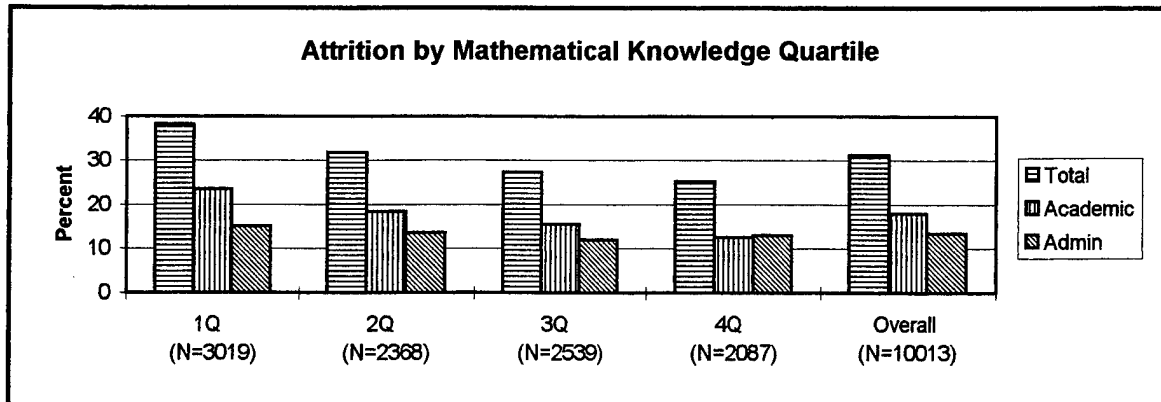

Figure 3. 8 Attrition by word knowledge quartile.

Figure 3.9 shows the attrition by coding speed. The ranges determined by the quartiles are: first quartile 22-53, second quartile 54-58, third quartile 59-63 and fourth quartile 64-72.

Figure 3. 9 Attrition by coding speed quartile.

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Figure 3.10 shows the attrition by mathematical knowledge subtest. The ranges determined by the quartiles are: first quartile 40-61, second quartile 62-64, third quartile 65-66 and fourth quartile 67-68.

Attrition by Mathematical Knowledge Quartile

Figure 3. 10 Attrition by mathematical knowledge quartile.

6. Education Level

The percentage of attrition levels for total, academic and administrative attrition by level of education are shown in Figure 3.11. The levels of education are divided into not completing high school, high school or equivalent, some college experience and bachelor's degree or above. The number of individuals with some college experience (3,902) and those who completed college or have advanced degrees (1,739) was surprising to the author; this represents a highly educated enlisted force who attended DLIFLC during fiscal years 1990 to 1996. Also note that there were very few individuals (26) who did not complete high school. Both academic and administrative attrition decreased as level of education increased, although administrative attrition decreased to a lesser extent than academic attrition.
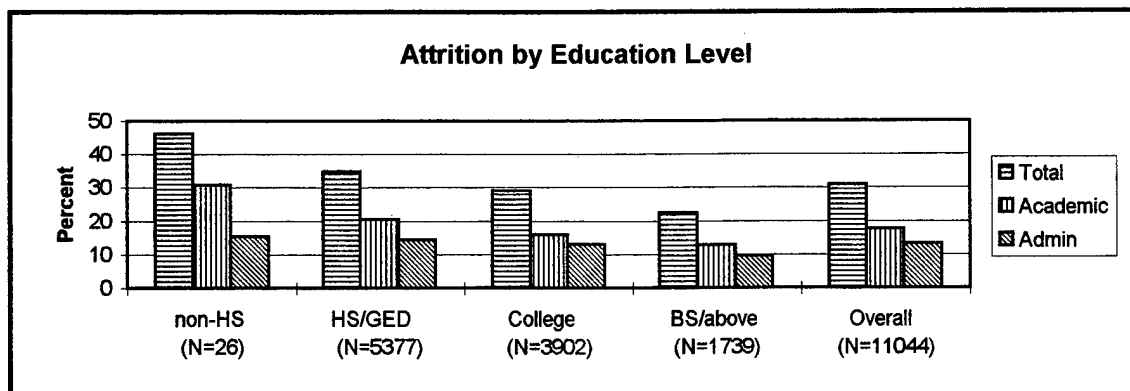
Attrition by Education Level

Figure 3. 11 Attrition by Education Level.

7. Input Category

Students enter courses at DLIFLC in different ways. The majority of the students begin the course as a regular input. About ten percent of the students restart the same language as a recycled input and a little more than one percent begin the course as a relanguaged input. The attrition by input category is displayed in Figure 3.12. Students who began the course as a recycled input academically attritted at a rate much lower than those who began as a regular or relanguaged input. Additionally, students who began as a recycled input administratively attritted at a much higher rate than those who began the course as a regular or relanguaged input.

Attrition by Input Category
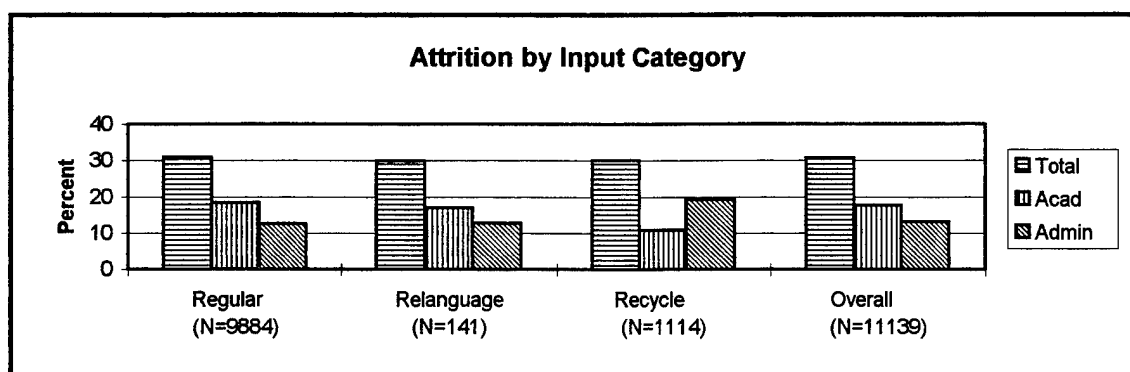
Figure 3. 12 Attrition by Input Category.

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8. Age

Figure 3.13 shows the attrition percentages by age. The age is based on that person's age when that specific class began; so if an individual were recycled or relanguaged, his/her age was updated to reflect the current status. The age of the student at the beginning of his/her class was divided into six, approximately equal levels. These levels were 17 and 18, 19, 20, 21 and 22, 23 and 24, and 25 or older. The distribution of academic and administrative attrition was approximately constant for ages 17 through 20. The academic attrition for 21 and older was about the same, but the administrative attrition was lower for the 23 and 24 year old group.
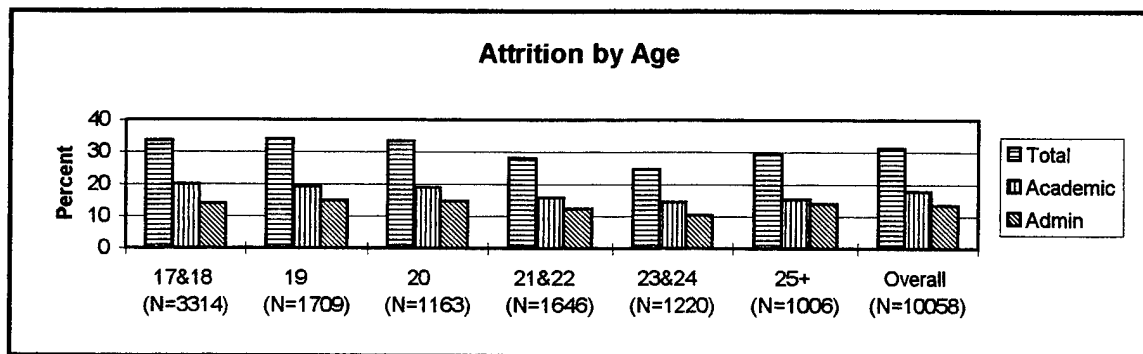
Figure 3. 13 Attrition by Age.

9. Marital Status

Figure 3.14 shows the attrition by marital status of the individual upon entrance to DLIFLC. This category was not updated if an individual were to change marital status over the time he/she attended DLIFLC. The categories are: single, married, and divorced. The only significant difference was that single people had about a 7 percent higher rate of administrative attrition than either married or divorced people.
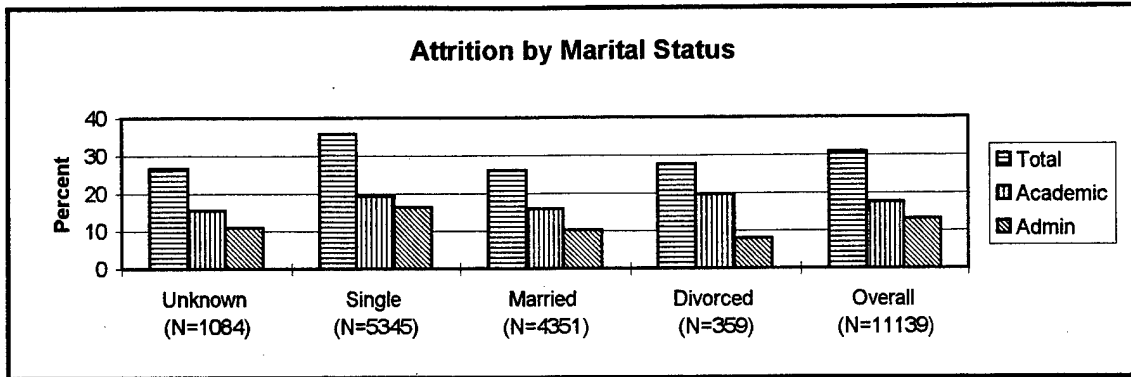
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Attrition by Marital Status

Figure 3. 14 Attrition by Marital Status.

10. Gender

Figure 3.15 displays attrition by gender. Male and female students displayed about the same total attrition; however, the male students had higher academic attrition and the female students had higher administrative attrition.
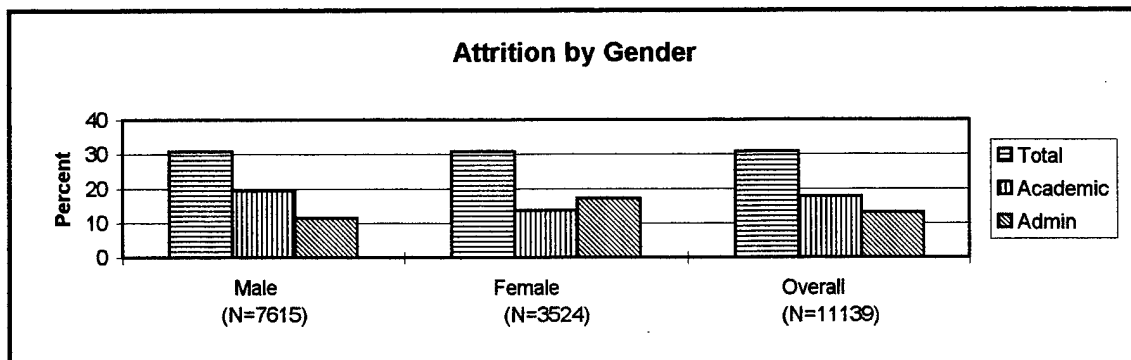
Attrition by Gender

Figure 3. 15 Attrition by gender.

11. Race

Figure 3.16 shows attrition by race. The race of the student was divided into six categories. These categories were: White, Black, Hispanic, American Indian/Alaskan Native, Asian/Pacific Islander, and other. The attrition of Hispanic and Asian/Pacific Islander students was slightly less than the overall average and the American Indian/ Alaskan Native was slightly greater than the overall average.
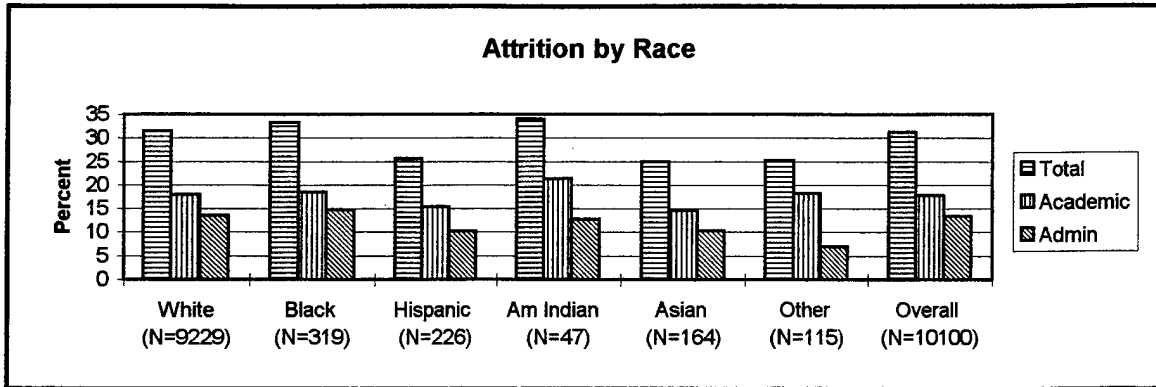
Figure 3. 16 Attrition by race.

12. Self-evaluated Motivation

Self-evaluated motivation is determined by the student's response on the DLIFLC student registration form. The form requests the student's response to:

LANGUAGE CHOICE: Below are five statements regarding your motivation for undertaking foreign language study. Find the statement that most closely corresponds to your choice and darken the appropriate circle.

I am here to study this language which is...

1. Not my choice. I would prefer to do something else rather than study a foreign language.

2. Not my choice. I am not motivated to study the assigned language.

3. Not my choice, but I am still motivated to study the assigned language.

4. Based on my second or third choice.

5. Based on my first choice.

Previous studies of self-evaluated motivation caution as to its validity in predicting motivation: "It should be noted that the item used to measure choice is ambiguous. Careful examination of the item reveals two conflicting underlying assumptions. One of these is that motivation can be inferred from choice; the other is that motivation is independent of choice (see option 3 in the item). There is probably some truth in both assumptions. It is thus unclear exactly what the item in fact measures, and one must

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therefore exert great caution in interpreting the results of statistical analyses of data derived from the item." (Jackson, G. L., et al., 1994)

Additionally, the item does not specify which of many possible times an individual may have been presented with a choice of languages to study. That is, the choice of languages offered by the recruiter may have been completely different from the choice of languages that the student was presented with upon entering DLIFLC. The difference in the choices may be due to needs of the service at that time or availability of billets for a specific language.

Attrition by self-evaluated motivation is shown in Figure 3.17. The sections of the figure are labeled by the five choices listed above. The academic attrition for the answers of 1- Not my choice. I would prefer to do something else rather than study a foreign language and 5-Based on my first choice were approximately the same. The administrative attrition displayed a lowering trend through the answers 1 through 5.
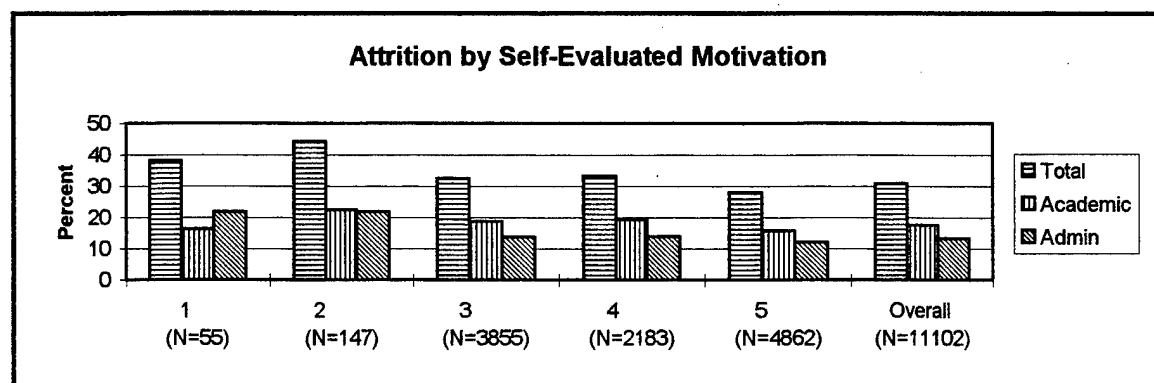

Figure 3. 17 Attrition by self-evaluated motivation.

B. THE VARIABLES

The variables have been described in the Data section above. A summary of the variables is presented here for easy reference.

1. Dependent variable

The dependent variable for this study is the disposition of the student at the end of the basic course of instruction. The possible student dispositions are graduation, academic attrition and administrative attrition.

2. Independent variables

The independent variables used for this study are summarized in Table 3.2.

Independent Variables		
Name	**Classification**	**Description**
Service	categorical	USA, USAF, USN, USMC
Unit	categorical	USA only A, B, C, D, E, F, G companies 7 - USAF M - USMC N - USN
Language Category	categorical	CAT I, CAT II, CAT III, CAT IV
DLAB	categorical	1Q - 0-99 2Q - 100-107, 3Q - 108-117 4Q - 118-161
AFQT	categorical	1Q - 0-78 2Q - 79-88 3Q - 89-94 4Q - 95-99
ASVAB Arithmetic Reasoning	categorical	1Q - 35-59 2Q - 60-62 3Q - 63-65 4Q - 66-96
ASVAB Word Knowledge	categorical	1Q - 1-57 2Q - 58-59 3Q - 60 4Q - 61-62
ASVAB Coding Speed	categorical	1Q - 22-53 2Q - 54-58 3Q - 59-63 4Q - 64-72
ASVAB Mathematical Knowledge	categorical	1Q - 40-61 2Q - 62-64 3Q - 65-66 4Q - 67-68
Education Level	categorical	not completed high school high school or equivalent some college experience bachelor's degree or above
Input	categorical	regular relanguaged recycled
Age	categorical	17 and 18 19 20 21 and 22 23 and 24 25 or older
Marital Status	categorical	single married divorced
Gender	categorical	male female
Race	categorical	White Black Hispanic American Indian/Alaskan Native Asian/Pacific Islander other
Self-evaluated Motivation	categorical	1-Not my choice. I would prefer to do something else rather than study a foreign language 2-Not my choice. I am not motivated to study the assigned language 3-Not my choice, but I am still motivated to study the assigned language 4-Based on my second or third choice 5-Based on my first choice

Table 3. 2 Independent variable descriptions.

IV. METHODOLOGY

The Data section described the variables and their general relationship to attrition. This section describes how the binary tree classification method is used to further evaluate these relationships between the disposition of students and the independent variables. Binary tree classification identifies the best set of predictor variables for classifying a student as a graduate, an academic attrit or an administrative attrit. Data from fiscal years 1994, 1995 and 1996 were used for this analysis.

A.   TREE STRUCTURE

The categorical structure of a tree is similar to that of a family tree with the oldest known ancestor at the top (root) of the tree followed on the next level by the offspring, the next level is comprised of their offspring and so on. A similar structure has been developed to determine the structure of a data set; this technique is known as Binary Classification Trees. Binary Classification Trees attempt to predict which class the dependent variable belongs in, based upon the values of the independent variables. Two types of trees can be "grown" using this method, classification trees and regression trees. The difference between a classification tree and a regression tree depends upon the dependent variable; if the dependent variable is categorical, the tree is a classification tree, if the dependent variable is numeric, then the tree is a regression tree.

Binary tree classification has several advantages over more familiar regression techniques. Binary tree classification is able to accommodate a mixture of categorical and numerical independent variables, is able to handle multiple responses, and provides a simple structure for evaluation. Also, because it is a nonparametric technique, no distributional assumptions are made.

A binary classification tree is grown from splits of the data into subsets and those subsets split into succeeding subsets until a stopping point is reached. The splits are determined to obtain the highest purity of the tree (this will be expounded upon later).

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The last node in a branch of a tree is known as the terminal or leaf node. There are three constructs which determine the growing of a tree; they are: the selection of the split, determining when to declare a terminal node and the assignment of the identity of the terminal node. (Breiman, et al. 1984)

1.   Growing a Tree

As an example of the tree classification method, the data for the basic Arabic course for fiscal years 1994 to 1996 is used. The dependent variable was dichotomous, either academic attrition or graduation, all of the records where an individual administratively attritted were removed. Since the dependent variable is categorical, the tree that is grown is a classification tree. The independent variables listed in Table 3.2 (page 27) were used to grow the tree. The method described in this example uses the program S-Plus (Mathsoft Inc., 1995).

The S-Plus tree function uses a recursive partitioning method that attempts to separate all the cases of a data set into nodes of a binary tree that are pure. Pure means that all the cases in each node are of the same type. For this example, a pure node would be one where all of the students in that node either graduated or all of the students in that node academically attritted.

The tree is allowed to grow to its maximum extent to reveal the complete structure of the data. If the tree were not allowed to grow sufficiently, it might leave significant structure undetected. The Arabic academic attrition tree that is produced in this example has 80 terminal nodes and is too complex for any relevant analysis. The optimum size for the tree is determined by methods called pruning and cross-validation, which will be discussed later. For now, the optimum size of the tree was determined to be six terminal nodes and the academic attrition tree for Arabic with six terminal nodes is shown in Figure 4.1.
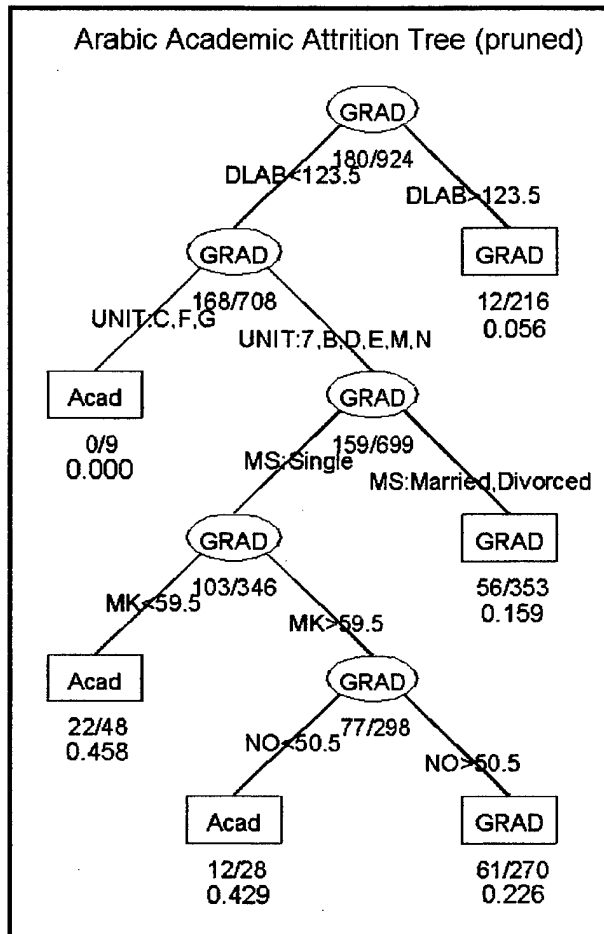
Figure 4. 1 Arabic Academic Attrition Tree (pruned).

The interpretation of the tree in Figure 4.1 is relatively simple. The root node contains all the students in the data set (this example does not include those students who administratively attritted), the node is labeled "GRAD", since the majority of the students in that node graduated. The misclassification rate below the root node is 180/924. This misclassification rate means that 180 of the 924 students in the basic Arabic course academically attritted. From this node, the program determines the best method to split into two descendant nodes. At each node the algorithm searches through M independent variables one by one, beginning with x_1 and continuing up to x_M. For this example, $M = 21$, x_1 = gender, x_2 = unit and so on through x_{21} = DLAB score. Considering the data at the root node, the algorithm evaluates every possible split for all variables, and picks the split that minimizes the deviance (maximizes the purity) of the node.

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S-plus uses the deviance (likelihood statistic) to measure the purity of each node and the tree. At each node i of a classification tree, the vector $\mu_i = (p_{i1}, ..., p_{ik})$ is the probability distribution over the k classes. Each case in node i is assumed to be drawn from a multinomial distribution with parameter, μ_i. At node i, n_{ik} cases are observed in class k, where $\sum_k n_{ik} = n_i$. The deviance at a node is defined as the negative of twice the log-likelihood,

$$D_i = -2\sum_k n_{ik} \ln p_{ik}.$$

The probabilities are estimated by $\hat{\mu}_i$ for node i,

$$\hat{\mu}_i = \left(\frac{n_{i1}}{n_i}, ..., \frac{n_{ik}}{n_i} \right).$$

The students in node i (the root node in this case) are then split into the two descendant nodes, l and r. The split would be made such that the decrease in deviance of the node,

$$\Delta D_i = D_i - D_l - D_r$$

is maximized.

The deviance of the root node is calculated for this example. As previously stated, there are two classes of students, "Acad" and "GRAD." Each case in the root node is assumed to be drawn from a multinomial distribution with $k = 2$. If $\hat{\mu}_1 = (\hat{p}_{11}, \hat{p}_{12})$, then $\hat{p}_{11} = prob\{'Acad'\}$ and $\hat{p}_{12} = prob\{'GRAD'\}$. At the root node, there are a total of $n_1 = 924$ students, $n_{11} = 180$ with level "Acad" and $n_{12} = 744$ with level "GRAD," giving $\hat{p}_{11} = \dfrac{180}{924}$ and $\hat{p}_{12} = \dfrac{744}{924}$, and the deviance at the root node is equal to:

$$-2\left[180\ln\frac{180}{924} + 744\ln\frac{744}{924} \right] = 911.3.$$

The first split of the students is based on the DLAB score. The split is made such that all the students scoring less than 123.5 go to the left child node (node 2) and all the students scoring greater than 123.5 go to the right child node (node 3). The split results in $n_2 = 708$ students in the left node and $n_3 = 216$ students in the right node. Of the 708

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students in the left node, $n_{21} = 168$ have the level "Acad" and $n_{22} = 540$ have the level "GRAD." Of the 216 students in the right node, $n_{31} = 12$ have the level "Acad" and $n_{32} = 204$ have the level "GRAD." The deviance of the left node is:

$$-2\left[168\ln\frac{168}{708} + 540\ln\frac{540}{708}\right] = 775.9,$$

and the deviance of the right node is:

$$-2\left[12\ln\frac{12}{216} + 204\ln\frac{204}{216}\right] = 92.7.$$

The purity of the tree is defined by the deviance of the tree,

$$D = \sum_j D_j,$$

where j is the set of all nodes on which splits have not yet been made. The sum of these deviances is 775.9+92.7=868.6. This gives the biggest change in deviance from the first level of the tree, which is the objective of the algorithm. (Chambers, J. M. et al., 1994)

2.   Determining the Optimum-sized Tree

The functions in S-Plus for determining the optimum size of the tree are pruning and cross-validation. The pruning method determines the deviance (or impurity) of the trees ranging in size from the tree of the root node only to the fully grown tree. The pruning method uses the deviance of the subtree plus a weighted penalty for the size of the tree to determine the best split. The weighted penalty is called the cost complexity parameter. As the size of the tree increases, the purity of the tree also increases, but the cost complexity parameter attempts to limit the size of the tree for ease of interpretation. Figure 4.2 shows the results from pruning the full tree in this example. This graph shows a relatively large reduction in deviance of the tree occurs from the first split. The next four splits decrease in their reduction in deviance. The following two larger "steps" are from combinations of splits, but they reduce the deviance to a lesser extent than the first couple of splits. There is a point in the process where the benefit of increased purity is

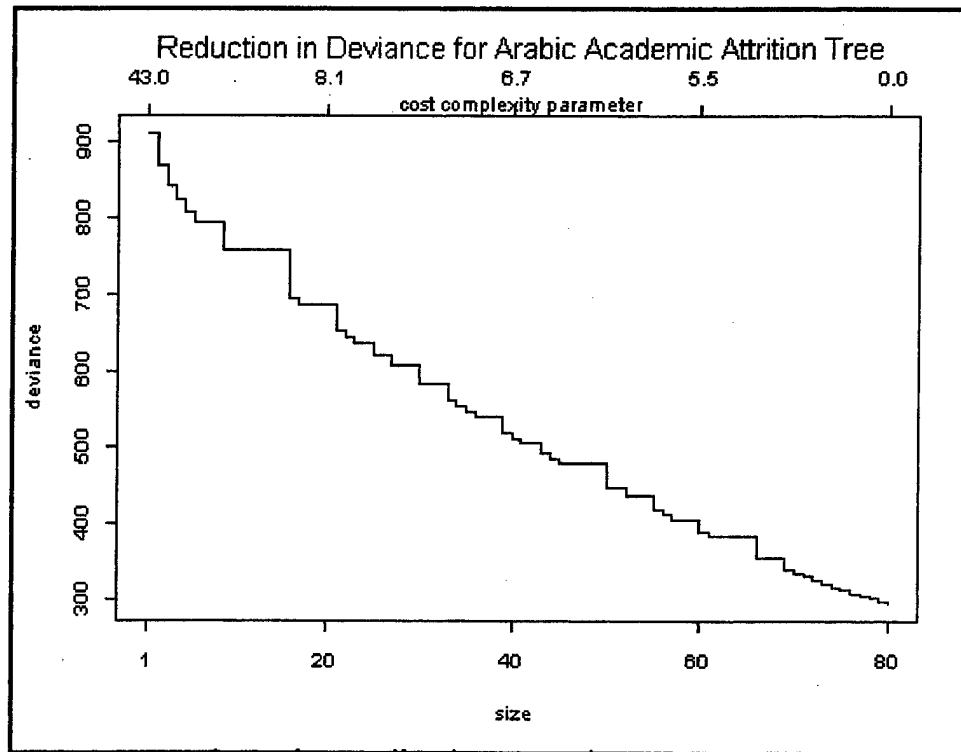countered by a tree's inability to accurately predict the response of cases not used to actually grow the tree.

Figure 4. 2 Deviation reduction from tree pruning.

Cross-validation is a method of determining the size of tree that optimizes both the purity of the tree and its ability to predict for new data. Cross-validation uses pruning to determine the optimum sized tree. Ten-fold cross-validation takes the complete data set and partitions it into ten nearly equal sets. Each set is removed in turn; then the remaining nine tenths of the data are used to grow a tree to its maximum size. The maximum sized tree is then pruned, resulting in a sequence of pruned trees similar to Figure 4.2. The one-tenth of the data that was removed prior to growing the tree is then applied to that specific sequence of pruned trees to test its predictive accuracy. The deviance from the cases applied to each of the pruned trees in the sequence is recorded.

The process is performed nine more times for each of the unique partitions of the data set. When this is completed, there are ten deviances recorded for each size in the sequence of pruned trees. Cross-validation plots the minimum deviance from all ten trees at each size in the sequence. In general, as the size of a tree increases, the deviance

decreases, until a point at which the size of the tree is so large that it loses its predictive power. This minimum point of deviance is the optimum size of the tree. Figure 4.3 is a plot of the ten-fold cross-validation for this example.
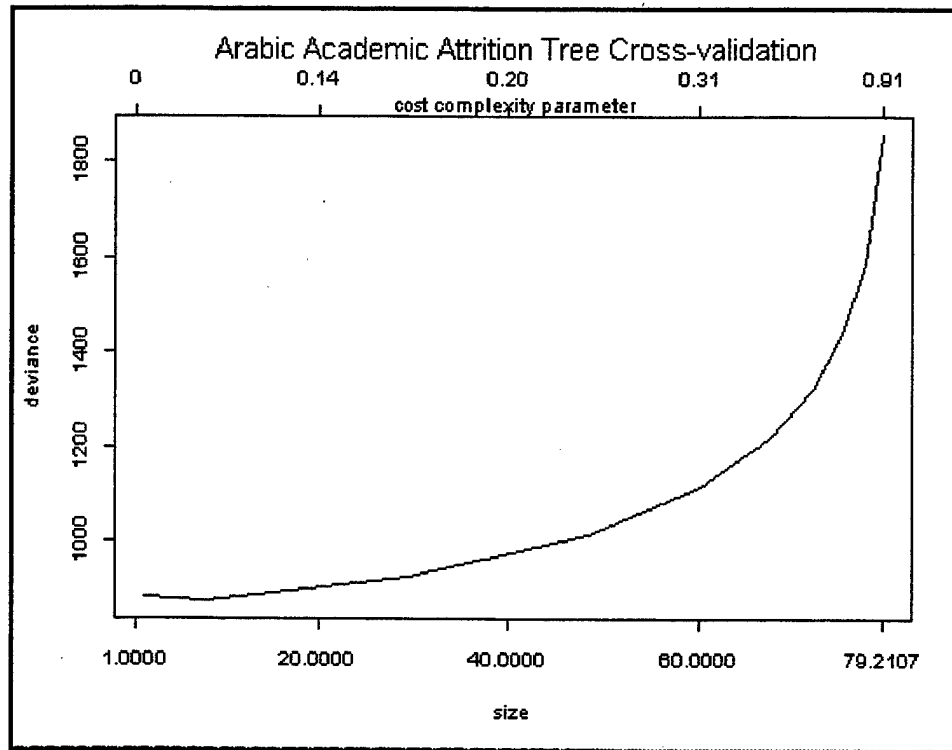

Figure 4. 3 Cross-validation of Arabic tree.

From the cross-validation plot the size of the optimum sized tree is between 6 and 8 terminal nodes, since the deviance reaches its minimum at this point. This reduction in deviance is not very decisive, but the optimum size of the tree is best determined by the minimum. Figure 4.1 (page 31) is the plot of a tree that has been pruned back to the optimum size based on the results of the ten-fold cross-validation.

B.   METHOD FOR THIS STUDY

Academic and administrative attrition were evaluated separately for each language. The variables used to evaluate both the academic and administrative attrition were: gender, unit, age, self-evaluated motivation, race, marital status, education level, service,

input category, AFQT score, ASVAB subtest scores and DLAB score. The scores of the tests (DLAB, AFQT and ASVAB subtests) were used vice the quartile ranges to allow the tree classification program to determine the best split based on the actual scores rather than the categorized quartile ranges.

1. All Language Category Method

One language from each language category was chosen to determine whether the independent variables could predict the disposition of a student for each of the language categories. The languages selected were: Category I - Spanish, Category II - German, Category III - Russian and Category IV - Arabic.

2. Spanish Input Category Method

If a student were having difficulty in a language, that student could be reassigned to another language. Since Spanish is a Category I language, and is one of the easier languages to learn, many students enter the basic Spanish course after failing to succeed in a more difficult language course. DLIFLC management is interested in determining whether the students who are relanguaged into the Spanish course have an effect on Spanish attrition. The binary tree classification method is used to perform this analysis. The data from fiscal years 1994 to 1996 is used for this analysis and split into the separate input categories so that trees can be grown for each input category. Therefore, analysis is performed on the data for the students who entered the course in the regular manner, as a recycled student and as a relanguaged student. Again, each of these groups were separated into two groups, those who academically attritted and those who administratively attritted. Therefore, six trees are grown in this analysis, two for each of the input categories.

V. RESULTS

A.   ALL LANGUAGE CATEGORIES

This section describes the results of the academic and administrative attrition tree analysis for Spanish, German, Russian and Arabic in fiscal years 1994, 1995 and 1996. The dependent variable was attrition (either academic or administrative on separate trees) and graduation. The independent variables used are listed in Table 3.2 (page 27). All of the trees were grown analyzing academic and administrative attrition separately since these trees provided more descriptive splits in the data than the trees grown with the dependent variable with all three options. The data were manually split into two groups, with graduation and academic attrition in one group and graduation and administrative attrition in the other group. For instance, for the Spanish attrition trees, 528 students graduated, 102 students academically attritted and 56 administratively attritted; the combination of those who graduated and those who academically attritted gives 630 students on the academic attrition tree and a misclassification rate at the root node of 102/630. Similarly, for the Spanish administrative attrition tree, the combination of those who graduated and those who administratively attritted was 584 students and a misclassification rate at the root node of 56/584. On the terminal nodes, the percent misclassification has been added for convenience.

The first language presented is Spanish, the Category I language. The optimally pruned tree for academic attrition for Spanish is displayed in Figure 5.1. As the tree shows, the variables which are the most important in predicting academic attrition for the basic Spanish course were the DLAB score, AFQT score and self-evaluated motivation. None of the students with both a high DLAB score (greater than 109.5) and a high AFQT score (greater than 86.5) academically attritted. Students who had a high DLAB score, but less than an 86.5 AFQT score, academically attritted at a rate of 11.1 percent. Students who had a lower DLAB score (less than 109.5), but had Spanish as their first choice, academically attritted at a rate of 12.1 percent. The highest rate of academic attrition was 25.3 percent; this was for students with a DLAB score less than 109.5 and who did not choose to learn Spanish as their first choice.
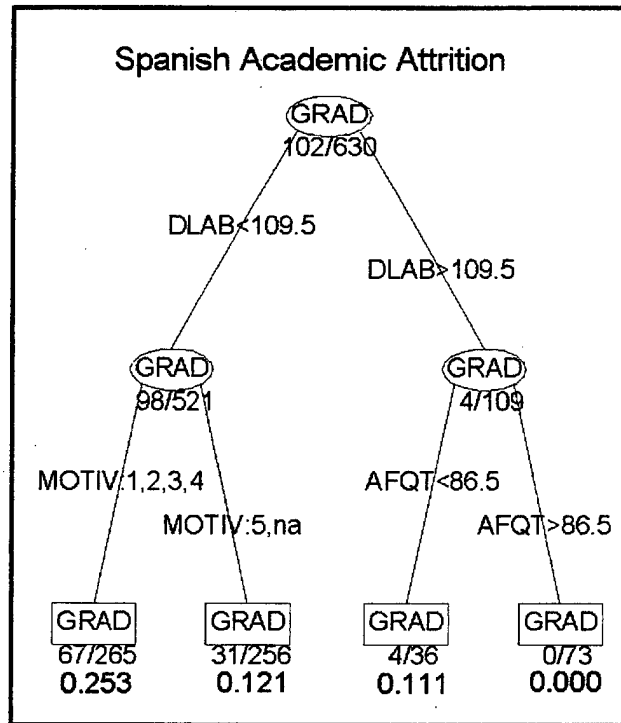
Figure 5. 1 Spanish Academic Attrition Tree.

The Spanish administrative attrition tree is shown in Figure 5.2. The most important variable in predicting administrative attrition was the student's input category. Students who entered the course as a regular student or as a relanguaged student administrative attritted at a rate of 8.5 percent. Students who were a recycled input administratively attritted at a rate of 24.3 percent.

Spanish Administrative Attrition

GRAD
56/584

IN:Regular
Relanguaged   IN:Recycled

GRAD   GRAD
46/543   10/41
0.085   0.243
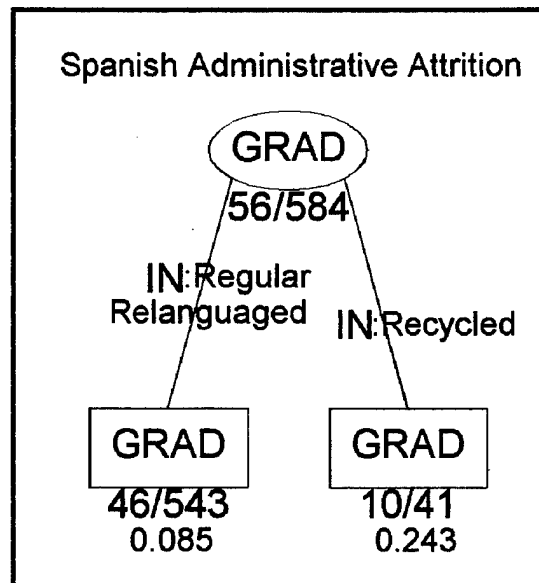
Figure 5. 2 Spanish Administrative Attrition Tree.

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The German academic attrition tree is displayed in Figure 5.3. The most significant split for academic attrition was education level. Thirty-three percent of the students who completed college or had advanced degrees academically attritted. Of the students with a high school education (or equivalent) or with some college experience and a DLAB score less than 93.5 20 percent academically attritted, while none with a DLAB score greater than 93.5 academically attritted.

German Academic Attrition

```
                        ( GRAD )
                         3/39
        EDUC:HS.GED,        \
        College  /            EDUC:BS.above
                /                    \
           ( GRAD )              [ GRAD ]
            1/33                   2/6
     DLAB<93.5   \                0.333
             /     DLAB>93.5
            /           \
      [ GRAD ]       [ GRAD ]
        1/5            0/28
       0.200          0.000
```
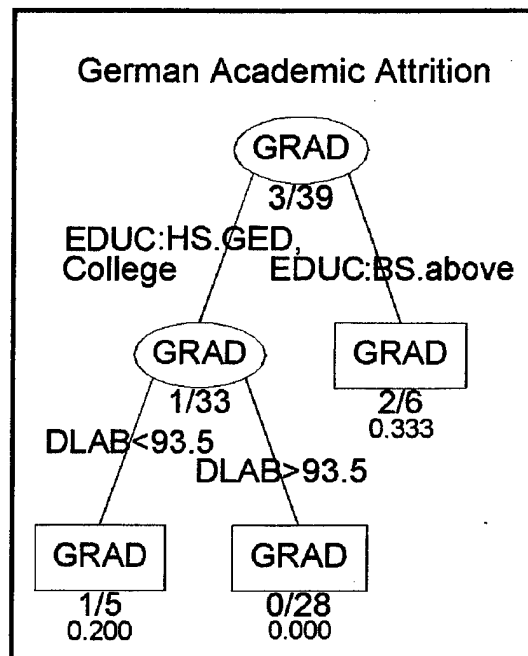
Figure 5. 3 German Academic Attrition Tree.

Students who were in the Air Force (7 on tree) or Charlie Company of the Army (C on tree) with an AFQT score less than 86.5 administratively attritted at a rate of 44.4 percent. As shown in Figure 5.4, none of the other students administratively attritted.
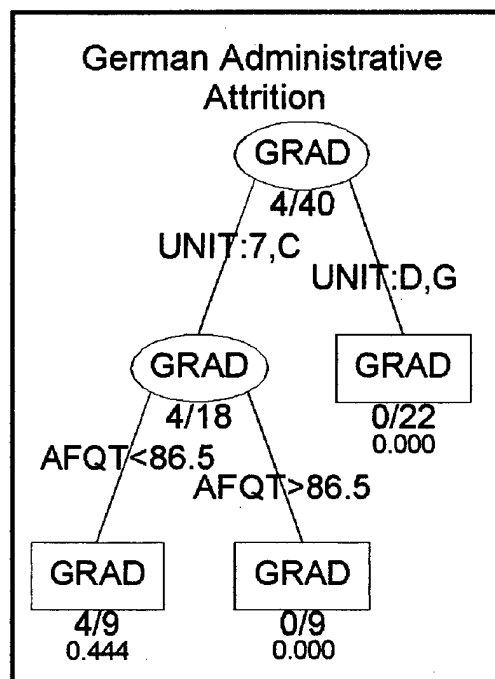
Figure 5. 4 German Administrative Attrition Tree.

The Russian academic attrition tree is shown in Figure 5.5. The root node of the tree shows that 148 out of 558 students academically attritted. The factors which were important in predicting academic attrition were DLAB score, student's unit, the arithmetic reasoning (AR) subtest of the ASVAB and self-evaluated motivation. The tree is difficult to describe in words, however the interested reader can follow the paths to each of the terminal nodes to determine the predictors for Russian academic attrition. The codes required to interpret the unit are: 7-Air Force, N-Navy, M-Marine Corps, C-Army Charlie Company, F-Army Foxtrot Company, and G-Army Golf Company. Note that academic attrition varies from 0 to 0.5.

Russian Academic Attrition
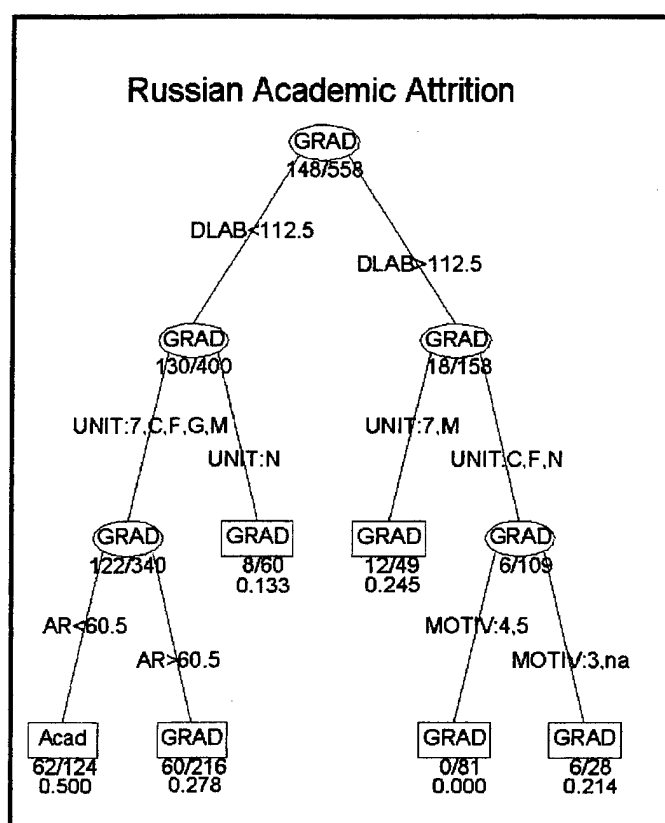
Figure 5. 5 Russian Academic Attrition Tree.

Figure 5.6 displays the Russian administrative attrition tree. A total of 104 out of 514 students attritted due to administrative reasons. The most significant factor was education level and the second most significant factor was DLAB score. Students who completed college or had advanced degrees administratively attritted at a rate of 7.3 percent. Students of other education levels with DLAB scores greater than 99.5 administratively attritted at 18.8 percent and those with DLAB scores less than 99.5 administratively attritted at 37 percent.
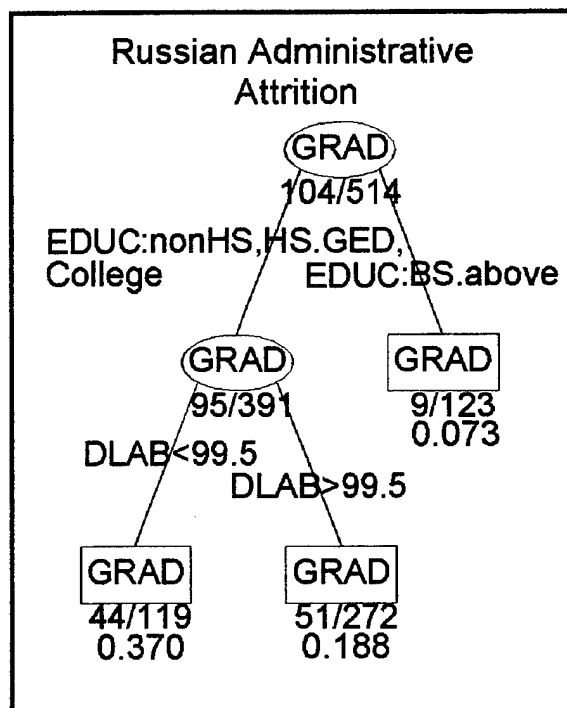
Figure 5. 6 Russian Administrative Attrition Tree.

The Arabic academic attrition tree is shown in Figure 5.7. The factors which were most important in predicting academic attrition were DLAB score, individual's unit, marital status, and the mathematical knowledge (MK) and numerical operations (NO)

subtests of the ASVAB. The interested reader can trace the paths to the terminal nodes to determine the best predictors. The terminal nodes that are labeled "Acad", have a majority of academically attritted students in those nodes and the misclassification rate below the node is for those who graduated. (E.g., All of the students who scored less than 123.5 on the DLAB and were in Charlie, Foxtrot or Golf Company of the Army academically attritted.) The codes required to interpret the unit are: 7-Air Force, B-Army Bravo Company, C-Army Charlie Company, D-Army Delta Company, E-Army Echo Company, F-Army Foxtrot Company, and G-Army Golf Company, M-Marine Corps and N-Navy.
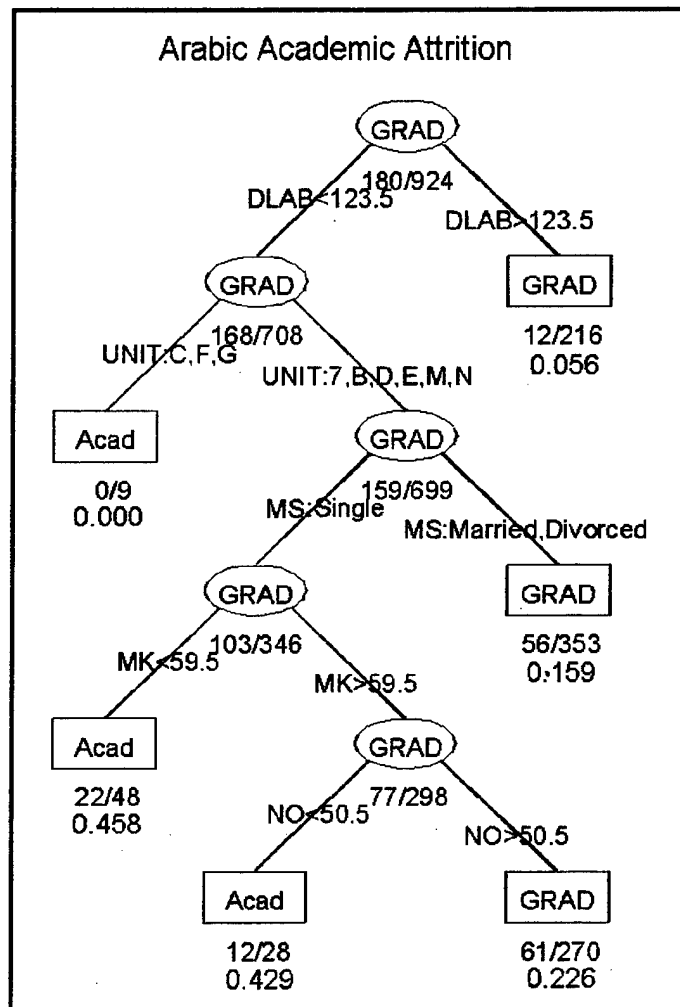
Figure 5. 7 Arabic Academic Attrition Tree.

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Figure 5.8 shows the Arabic administrative attrition tree. The most significant factors were education level and marital status. Students who did not complete high school or completed college or had advanced degrees, administratively attritted at a rate of 8.7 percent. Those who completed high school or had some college experience and were married or divorced administratively attritted at a rate of 15.5 percent while single students administratively attritted at 26.8 percent.
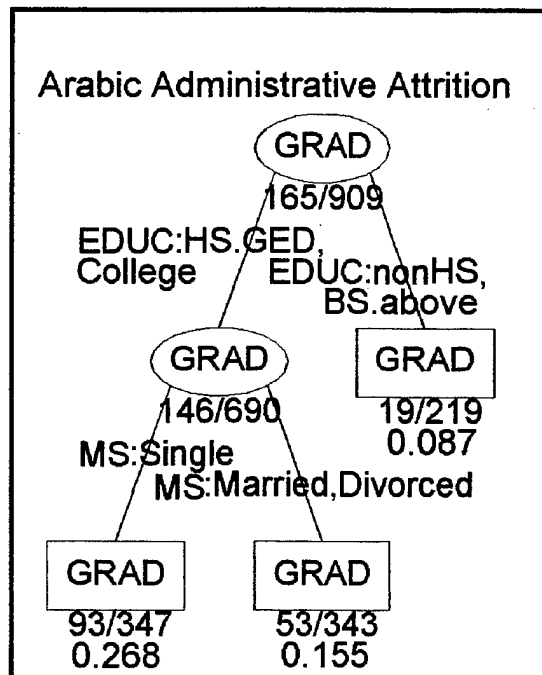
Figure 5. 8 Arabic Administrative Attrition Tree.

B. SPANISH REGULAR, RECYCLED AND RELANGUAGED ANALYSIS

The academic attrition tree for regular inputs into the basic Spanish course is shown in Figure 5.9. The variables that were most important in determining if a student would academically attrit were DLAB score, self-evaluated motivation, unit and AFQT score. Students academically attritted at the highest rate of 29.3 percent were those with a DLAB score of less than 109.5 and who did not say Spanish was their first, second or third choice of language learning. Other academic attrition rates can be determined by following the path to the terminal node. (The unit codes are: 7-Air Force, G-Army Golf Company, M-Marine Corps, C-Army Charlie Company, and N-Navy.)
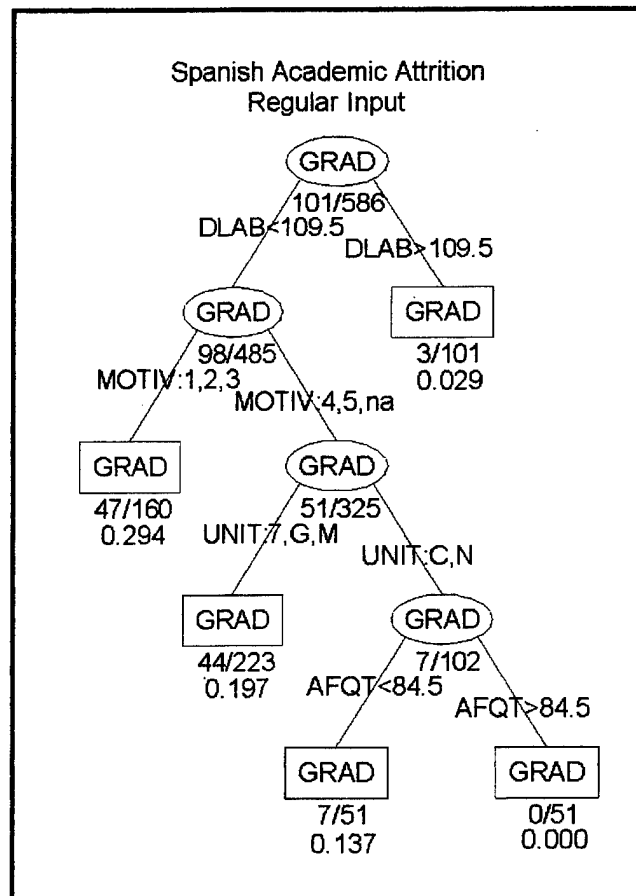
Figure 5. 9 Spanish Academic Attrition Regular Input.

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Figure 5.10 displays the Spanish administrative attrition for students who were regular inputs. The best variable in predicting administrative attrition was the student's score on the auto and shop information (AUTO) subtest of the ASVAB test.
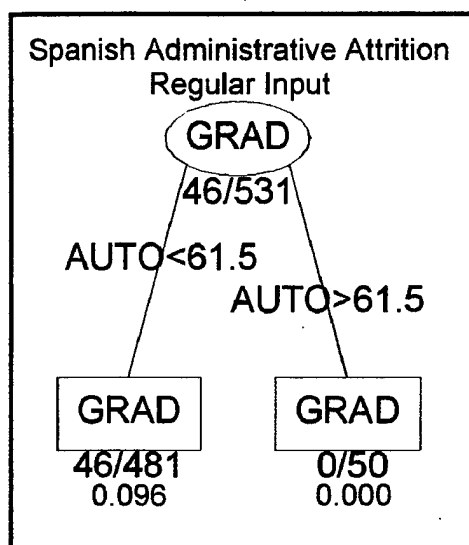
Figure 5. 10 Spanish Administrative
Attrition Regular Input.

The Spanish academic attrition tree for recycled students is shown in Figure 5.11. The most significant predictor of academic attrition was the student's score on the word knowledge (WK) subtest of the ASVAB.
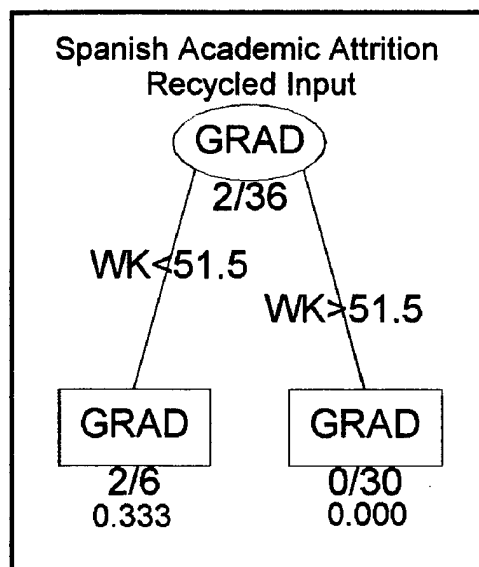

Figure 5. 11 Spanish Academic Attrition
Recycled Input.

The best predictor of administrative attrition for recycled students was the student's branch of service. Figure 5.12 shows the students in the Army and the Marine Corps administratively attritted at a rate of 33.3 percent. None of the students in the Navy and Air Force who were recycled in the Spanish course administratively attritted.

Spanish Administrative Attrition
Recycled Input

GRAD

12/46

SERV:USA,USMC

SERV:USN,USAF

GRAD

12/36
0.333

GRAD

0/10
0.000
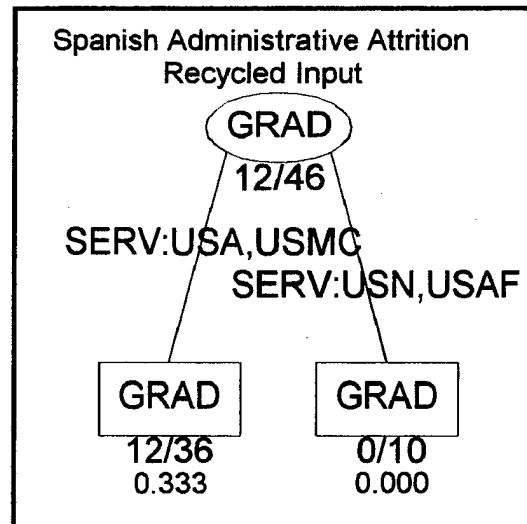
Figure 5. 12 Spanish Administrative Attrition Recycled Input.

Academic attrition for a relanguaged student into the basic Spanish course was most dependent upon the variables of self-evaluated motivation, unit and the numerical operations (NO) subtest of the ASVAB, as shown in Figure 5.13. None of the students who were relanguaged out of the course that originally was their first choice academically attritted. Students from the Air Force, Marine Corps and Alpha or Charlie Company of the Army who were motivated or did originally receive their second or third language choice academically attritted at a rate of 5.9 percent. Students from the Navy or Golf Company of the Army and scored less than 54.5 on the numerical operations subtest of the ASVAB and did not originally receive their first choice of language study academically attritted at a rate of 22.2 percent. The highest rate of academic attrition was the 83.3 percent observed among students in the Navy or Golf Company of the Army who scored greater than 54.5 on the numerical operations subtest of the ASVAB and did not originally receive their first choice of language study.

Spanish Academic Attrition
Relanguaged Input
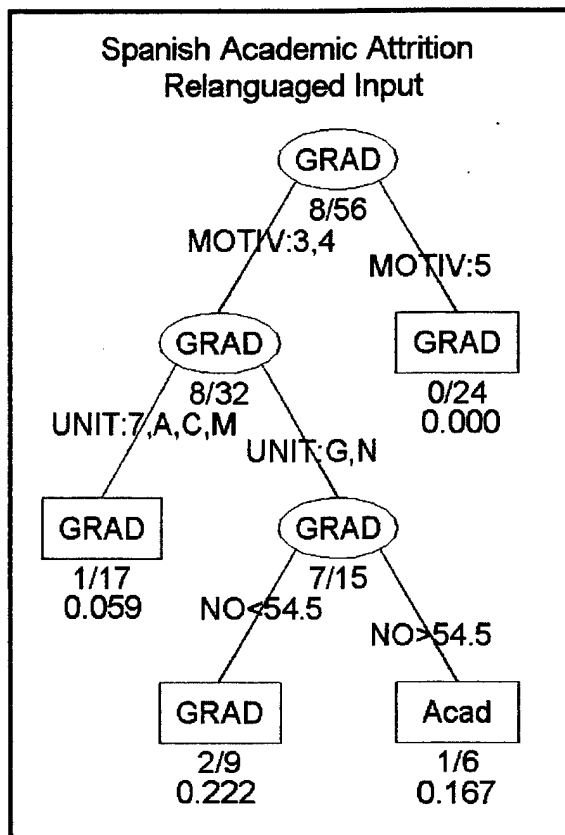
Figure 5. 13 Spanish Academic Attrition
Relanguaged Input.

The administrative attrition for relanguaged inputs is shown in Figure 5.14. The variable which best describes the risk of administrative attrition is the electronics information (EI) subtest of the ASVAB.
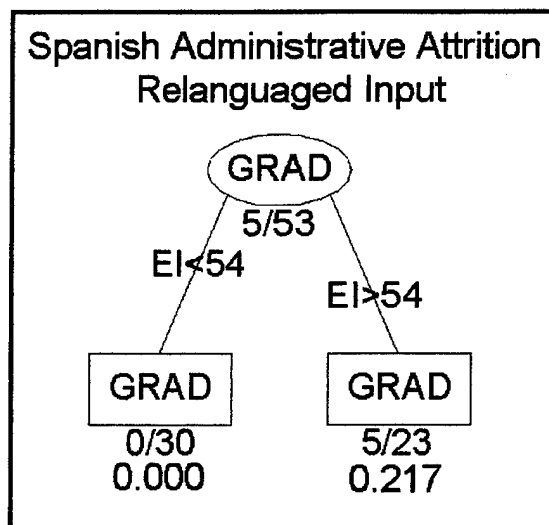

Figure 5. 14 Spanish Administrative Attrition Relanguaged Input.

VI. DISCUSSION AND CONCLUSIONS

A. ACADEMIC ATTRITION FOR ALL LANGUAGES

The attrition by fiscal year for all of the fiscal years considered in this study is displayed in Figure 6.1. When put in perspective over fiscal years 1990 to 1996, the rising trend in attrition for fiscal years 1994 to 1996 was not too dramatic. Fiscal year 1996 attrition is not much greater than the attrition for the overall average of all of the fiscal years. These fluctuations in attrition rates may be due, at least in part, to changes in DLIFLC command-level policy on recycling and/or relanguaging students as well as changes in command goals for attrition. Additionally, the 1974 Army Linguist Personnel Study found an overall attrition rate of 28.7 percent which is not that far off the fiscal year 1996 or overall attrition rates. Therefore, when placed in historical perspective and viewed over the long term, the rise in attrition from fiscal year 1994 to 1996 was probably not significant.
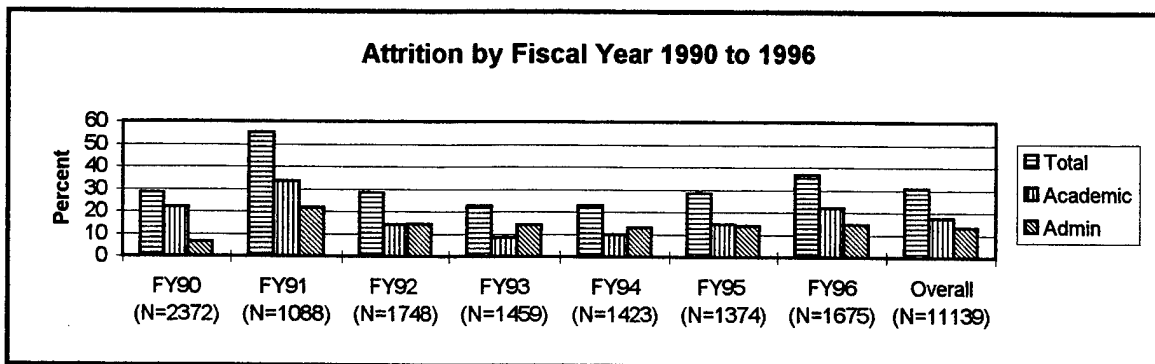
Figure 6. 1 Attrition by Fiscal Year 1990 to 1996.

In the four academic attrition trees, the DLAB score was the best predictor of academic attrition in all languages except German, where it was the second best predictor (the first being level of education). Additionally, the DLAB score where the split occurred increased as the language categories increased, except for German where the split was at a lower level than for Spanish. For Russian and Arabic, the Category III and IV languages, the student's unit was the second best predictor for academic attrition. The Army

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companies Charlie, Golf and Foxtrot displayed the highest academic attrition in these two languages. Self-evaluated motivation was a second-level predictor in Spanish and a third-level predictor in Russian of academic attrition; students who received their first choice in Spanish and their first, second or third choices for Russian academically attritted at a lower rate. The level of education was a predictor of academic attrition only on the German academic attrition tree; for German it was the best predictor of academic attrition. This is not a very significant result though, since there were only 3 out of 39 students who academically attritted from the German course in the three years. Other test scores (AFQT, Arithmetic Reasoning, Mathematics Knowledge, and Numerical Operations subtests of the ASVAB) were lower-level predictors of academic attrition on different trees. It is interesting that test scores in mathematical reasoning were also predictors of academic attrition for language learning.

B. ADMINISTRATIVE ATTRITION FOR ALL LANGUAGES

The level of education was the best predictor of administrative attrition for Russian and Arabic. Students who completed college or had advanced degrees had a lower level of administrative attrition in Russian and Arabic; for Arabic this split included students who did not complete high school. For Spanish, the most significant predictor of administrative attrition was how the student entered the course; those who entered as a regular input or a relanguaged input administratively attritted at a much lower rate than those who entered as a recycled input. This was the only place on all the trees where input category was even a predictor of attrition, either academic or administrative. For German, the only students who administratively attritted were in Charlie Company of the Army or in the Air Force. (Recall that there were no Marine Corps or Navy students in German over the three fiscal years.) The student's unit was the most significant predictor of administrative attrition for German.

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C.   SPANISH ATTRITION

The individual's self-evaluated motivation and unit were the best predictors of academic attrition (after the DLAB score for a regular input). Individuals who received one of their first three choices of language instruction attritted at a lower rate (15.7 percent) than other students (29.4 percent). Note that none of the students who received their first choice of language instruction and then were relanguaged into Spanish academically attritted.

The Spanish administrative attrition tree for recycled inputs shows that the Navy and the Air Force had more success than the Army and Marine Corps in selecting students who should be recycled. Subtests of the ASVAB were the best predictors of administrative attrition for both regular and relanguaged inputs. This is only significant in that none of the other independent variables are good predictors of administrative attrition and therefore administrative attrition was difficult to predict with these variables.

D.   CONCLUSIONS

The score on the DLAB was the best predictor of academic attrition for this study. The DLAB scores where the splits were made were higher than the minimum required scores for entering into a course in a language category, but this study confirmed the trend that students with higher DLAB scores were more likely to succeed in language learning. This result agrees with prior studies on DLIFLC attrition.

This study also showed that there was a difference between the services and within the Army units in predicting both academic and administrative attrition. This difference may be due to the difference in assignment of students to their language and when that assignment was made. For example, Navy students were not assigned their course of study until after arrival at DLIFLC and an initial interview. Other services assigned students to their language during the recruiting process. The Air Force has recently developed a program to try to reduce their attrition by instituting an indoctrination course for language learning prior to a student beginning his/her course of study.

Students who were able to complete college or obtain an advanced degree were less likely to administratively attrit in the more difficult languages of Russian and Arabic. This may show that a student who has shown success at completing a program in the past may have more success at completing a course in language training.

In reference to the issue of relanguaging and recycling students; for all languages over the seven fiscal years, a relanguaged student and a regular input student displayed virtually equal attrition rates. A student who was recycled displayed a much lower academic attrition rate (11 percent versus 18 percent for a regular input) and a much higher administrative attrition rate (20 percent versus 13 percent for a regular input).

For the Spanish course, the number of inputs who were relanguaged into Spanish was greater than in the other languages; however, this did not prove to be a predictor of academic attrition. An Air Force or Navy student who was a recycled input in the Spanish course administratively attritted at a much lower rate than a student who was recycled from the Army or the Marine Corps. This may show that the Navy and Air Force looked at other factors that could cause the student to have problems prior to making the decision to recycle the student in the Spanish course.

E.   AREAS OF FUTURE STUDY

Areas which could be studied in the future would be to confirm that there is a difference in attrition between the services and within the Army, and to try to establish reasons why this difference exists.

When data are available to evaluate the impact of the Air Force's indoctrination program, a study could be performed to determine if this has made a difference in the success of an Air Force student in language learning.

The issue of recycling and relanguaging students could continue to be studied by determining whether these students differ in grade point average and/or scores on the DLPT or other tests.

APPENDIX. VARIABLE RELATIONSHIPS

For each of the variables examined in this study, this appendix describes the relationship between the variable and the services and language categories for fiscal years 1990 through 1996.

Figure A.1 shows the percentage of individuals in the four language categories separated by service. The Marine Corps had the highest percentage of students in Category I languages, about twice the percentage of the other services. The Navy and Marine Corps trained no students in Category II languages in FY90 through FY96 and the Army trained a higher percentage of students than the Air Force in Category II languages. The Navy trained a significantly higher percentage of students in Category III languages than the other services. The Air Force, closely followed by the Marine Corps, trained a higher percentage of students in Category IV languages than the other services. With other variables being equal, one could hypothesize the Air Force would have higher attrition than the other services since the Air Force assigned a higher percentage of students to the most difficult language category. Additionally, one could hypothesize the Marine Corps would have lower attrition since the Marine Corps assigned a higher percentage of students to the easiest language category, although this cannot be conclusive since the Marine Corps also assigned a high percentage of students to the most difficult language category.
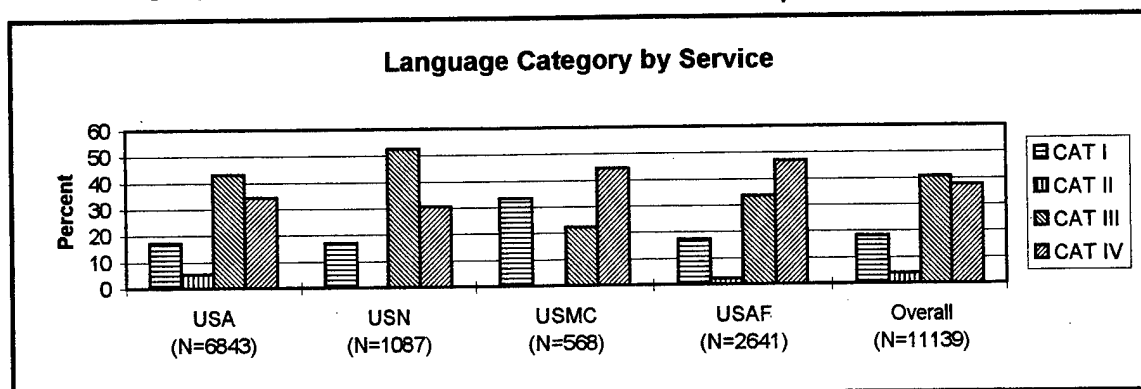
Figure A. 1 Language Category by Service.

Figure A.2 shows the distribution of Army Units by Language Category. The greatest percentage of Alpha Company students were in Category IV languages. The

majority of Bravo Company students were in Category I languages. Charlie, Delta and Foxtrot Companies had the majority of their students in Category III languages. Golf Company had the majority of their students in Category II languages.
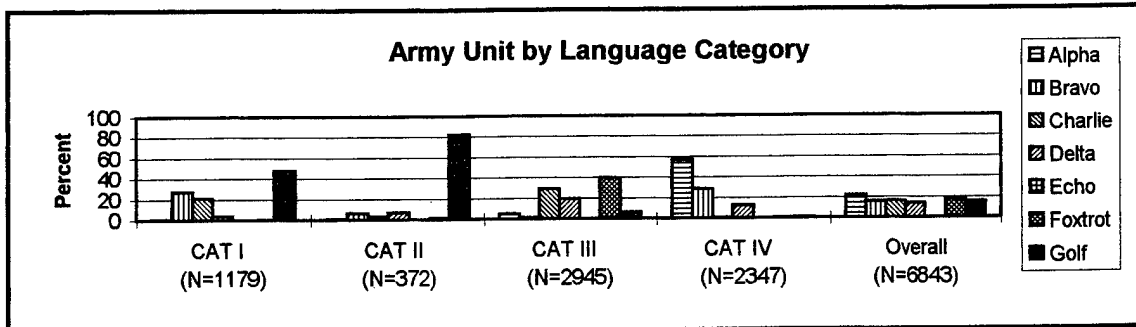
Army Unit by Language Category

Figure A. 2 Army Unit by Language Category.

Figure A.3 displays the percentage of individuals with DLAB scores divided by quartiles by service. The ranges determined by the quartile scores are: first quartile, 0-99; second quartile, 100-107; third quartile, 108-117; and fourth quartile, 118-161. The only service that displayed a rising trend over all four quartiles is the Navy, the Army had the reverse trend. The Marine Corps and the Air Force displayed similar distributions with a jump between the first and second quartiles followed by a lowering trend. If other variables were maintained constant, one could hypothesize from Figure A.3 that the Navy would have lower attrition than the other services since the Navy had the highest percentage of students in the upper DLAB quartile and that the Army would have the highest attrition since the Army had the highest percentage of students in the lowest DLAB quartile.

DLAB Quartile by Service
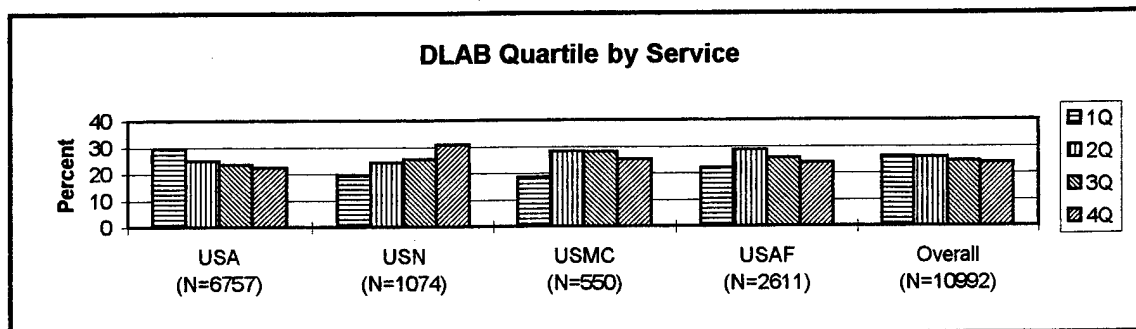
Figure A. 3 DLAB Quartile by Service.

The DLAB quartiles are displayed by Language Category in Figure A.4. DLIFLC entrance requirements for each of the Language Categories are: Category I - 85, Category II - 90, Category III - 95, and Category IV - 100. The ranges determined by the quartile scores are: first quartile, 0-99; second quartile, 100-107; third quartile, 108-117; and fourth quartile, 118-161. The only quartile affected by these entrance requirements was the first quartile (0-99) since these individuals did not meet the entrance requirement for category IV languages and may not have met the requirements for the other language categories. Figure A.4 displays the lower category languages with the majority of the lower DLAB quartiles and the higher category languages with more of the higher DLAB quartiles. This trend was expected since higher language aptitude students are assigned to the more challenging language categories.
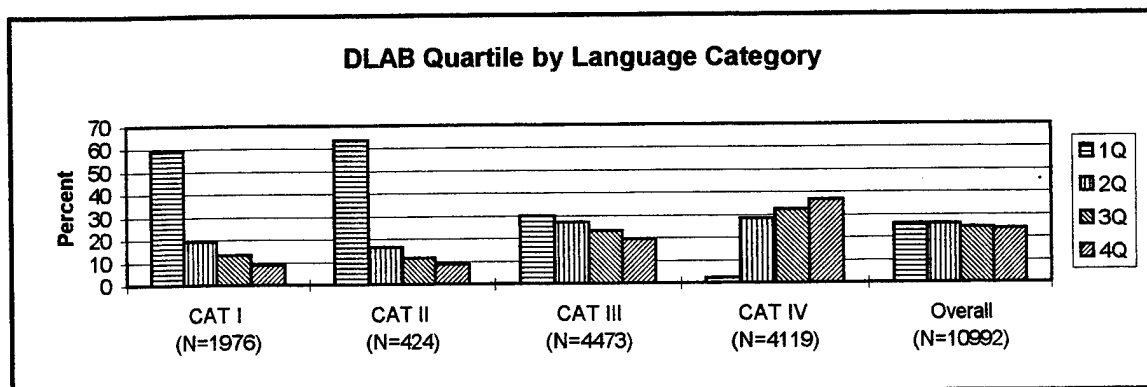
Figure A. 4 DLAB Quartile by Language Category.

Figure A.5 displays the AFQT quartile when divided by service. The ranges of the AFQT quartiles were: first quartile, 1-78; second quartile, 79-88; third quartile, 89-94; and fourth quartile, 95-99. The Air Force and the Marine Corps had the lowest percentage of students in the first quartile and the Air Force had the highest percentage of students in the second quartile. The Navy had the most even distribution among all four quartiles. If all other factors were held constant and the AFQT quartile were a predictor of language learning success, one could hypothesize the Air Force and Marine Corps would have lower attrition since both had a lower percentage of first quartile AFQT scores.
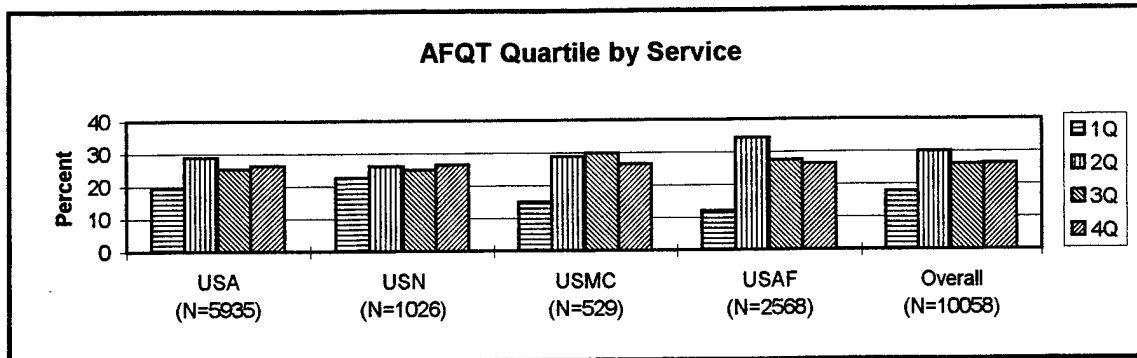
AFQT Quartile by Service

Figure A. 5 AFQT Quartile by Service.

Figure A.6 displays the AFQT Quartile when separated by Language Category. There was a generally decreasing trend of the first quartile as the language categories get more difficult. Category II languages had a slightly higher concentration of the two lower AFQT quartiles than Category I languages and a significantly lower concentration of the two upper quartiles than Category III languages. Therefore, one might hypothesize more attrition from Category II languages if all other variables were held constant.

AFQT Quartile by Language Category
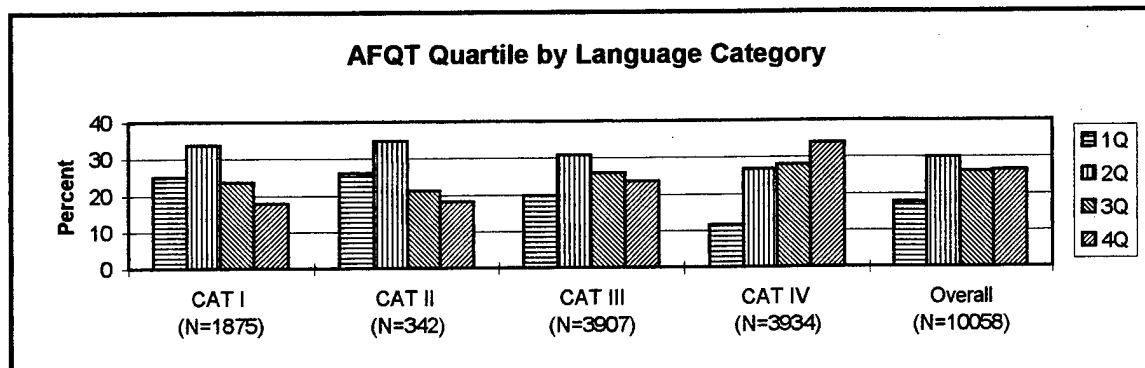
Figure A. 6 AFQT Quartile by Language Category.

The attrition by ASVAB subtests are displayed in Figures A.7 through A.12.

Attrition by Paragraph Comprehension Quartile
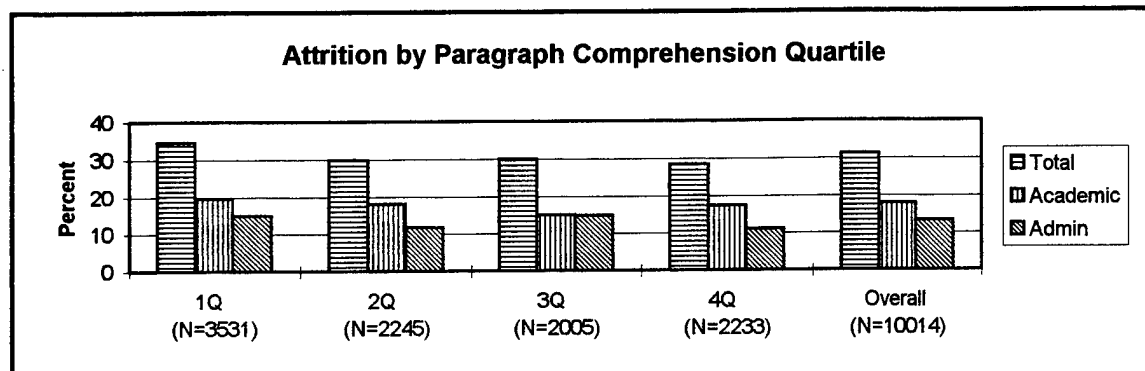
Figure A. 7 Attrition by Paragraph Comprehension Quartile.

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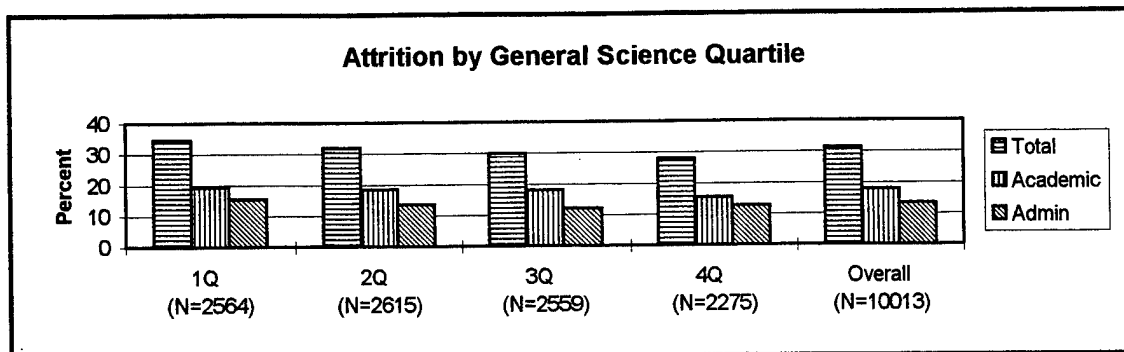
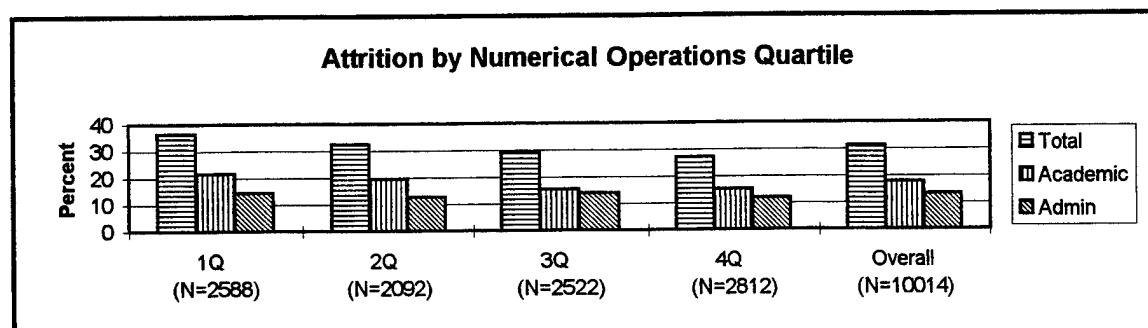**Figure A. 8** Attrition by General Science Quartile.

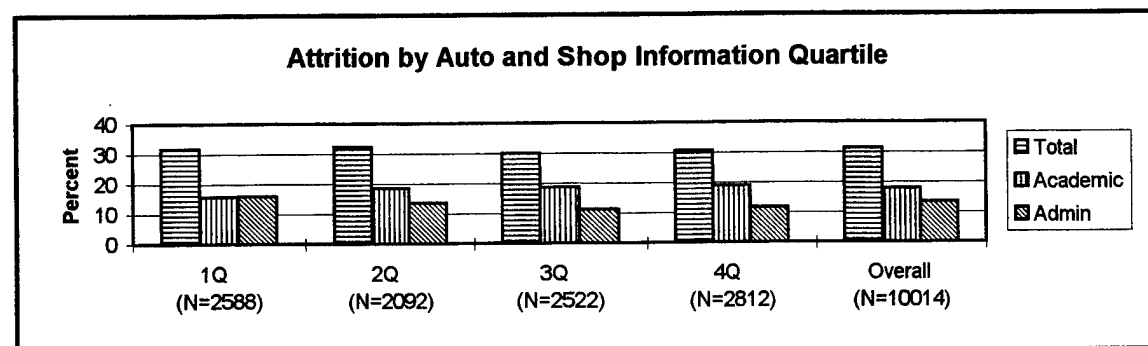**Figure A. 9** Attrition by Numerical Operations Quartile.

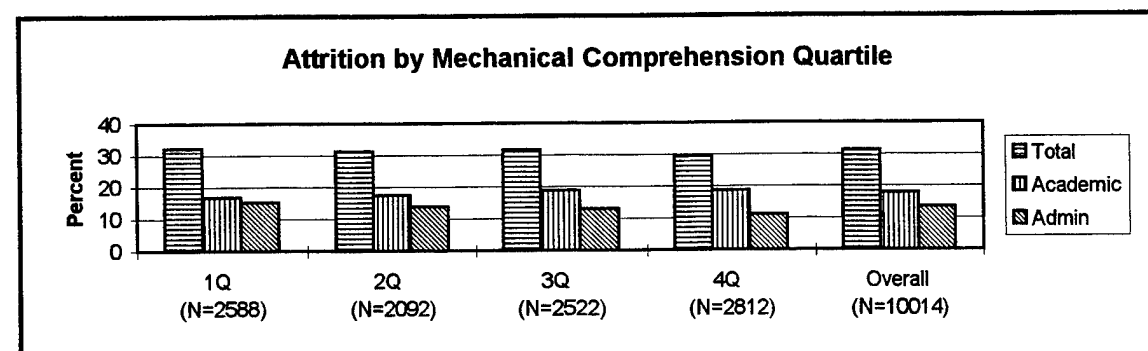**Figure A. 10** Attrition by Auto and Shop Information Quartile.

Figure A. 11 Attrition by Mechanical Comprehension Quartile.
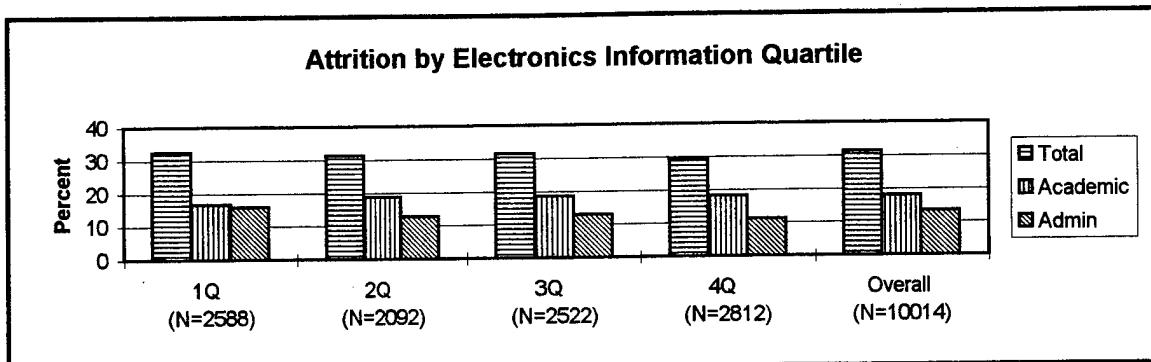
Attrition by Electronics Information Quartile

Figure A. 12 Attrition by Electronics Information Quartile.

Figure A.13 displays the variation of the level of education by service. The Marine Corps had the overall lowest level of education as determined by the higher percentage of individuals with a high school or equivalent education than the other services. Likewise, the Air Force was determined to have the overall highest level of education due to the higher percentage of individuals with some college experience than the other services. One might therefore hypothesize that with the effects of variables other than education being equal, attrition might be higher for the Marine Corps than the other services and lower for the Air Force than other services.
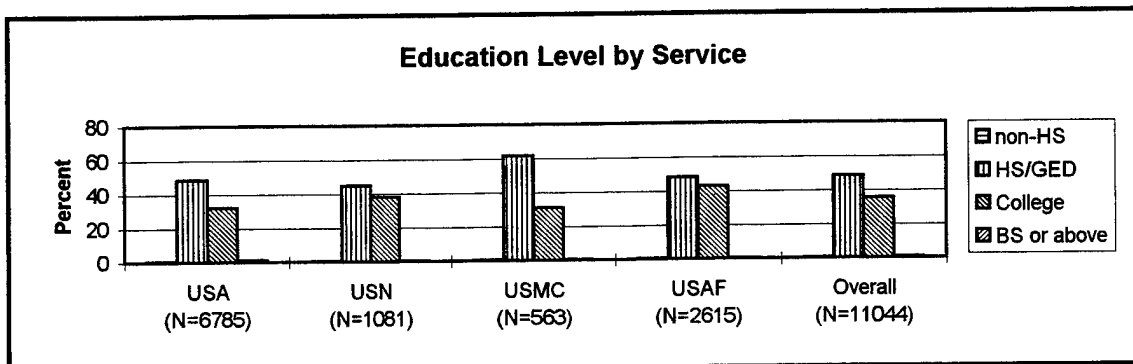
Education Level by Service

Figure A. 13 Level of Education by Service.

The level of education by language category is displayed in Figure A. 14. The level of education was higher for the Category IV languages than for the Category I languages as shown by the generally increasing trend in the percentage of individuals with some college experience from Category I to Category IV. The assignment of more educated individuals to more difficult language categories was expected and one could hypothesize there will be little effect of education level by language category on attrition.

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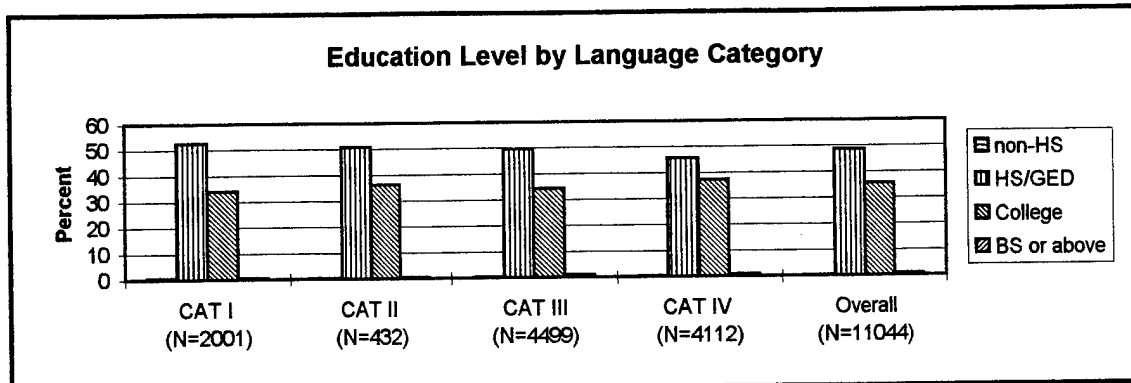**Education Level by Language Category**

Figure A. 14 Level of Education by Language Category.

Figure A.15 displays the distribution of students' age when divided by service. The Marine Corps had a higher concentration of younger students and the Army and the Navy with a higher concentration of older students. Therefore if attrition were based on age only, one would expect the Marine Corps to have higher attrition.
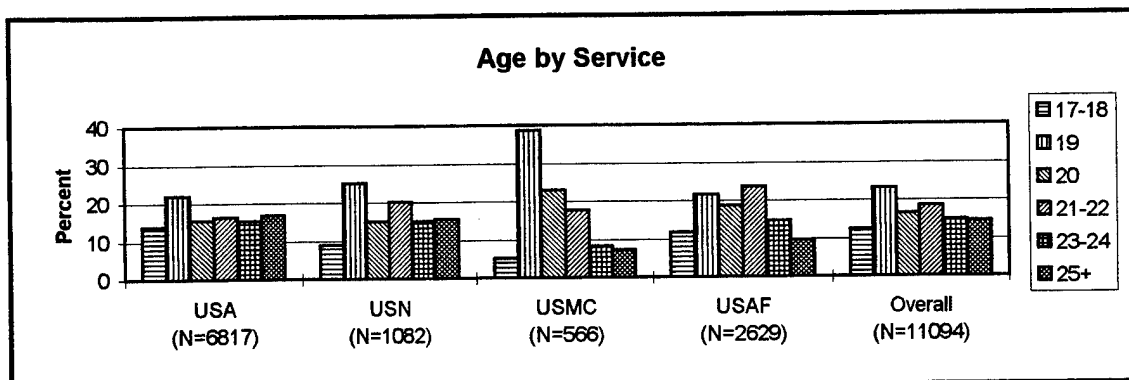
Age by Service

Figure A. 15 Age of students divided by service.

Figure A.16 displays the distribution of the age of students when divided by Language Category. In general there was a higher concentration of younger students in the lower category languages than in the higher category languages. Therefore, one could hypothesize there would be more attrition in the lower category languages, with the younger students, than in the higher category languages, if all other variables were held constant.
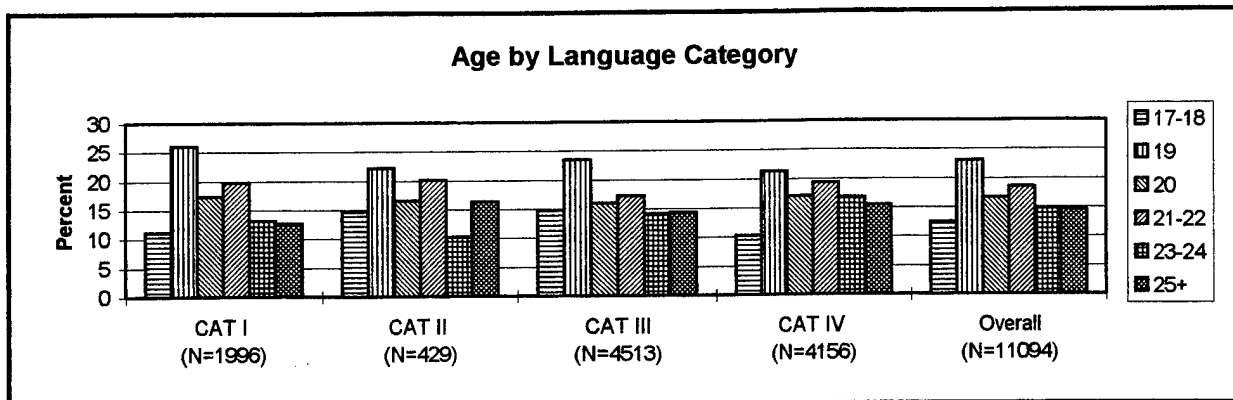
Figure A. 16 Age of the student divided by Language Category.

Marital Status by service is shown in Figure A.17. The Air Force was the only service with a greater percentage of married students than single students. Since single students displayed a higher administrative attrition rate than other categories and the Air Force had a greater percentage of married students, one could conclude that the Air Force could have a lower percentage of administrative attrition than the other services.
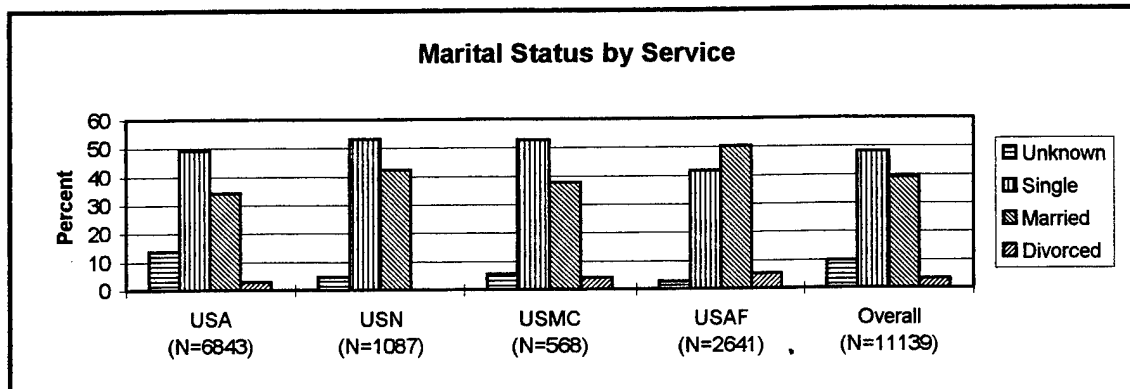

Figure A. 17 Marital Status by Service.

Marital Status by Language Category is shown in Figure A.18. Category I languages had the highest concentration of single students and Category IV languages have the highest concentration of married students. If marital status were a predictor of administrative attrition, one could conclude that Category I languages would display a higher percentage of administrative attrition.
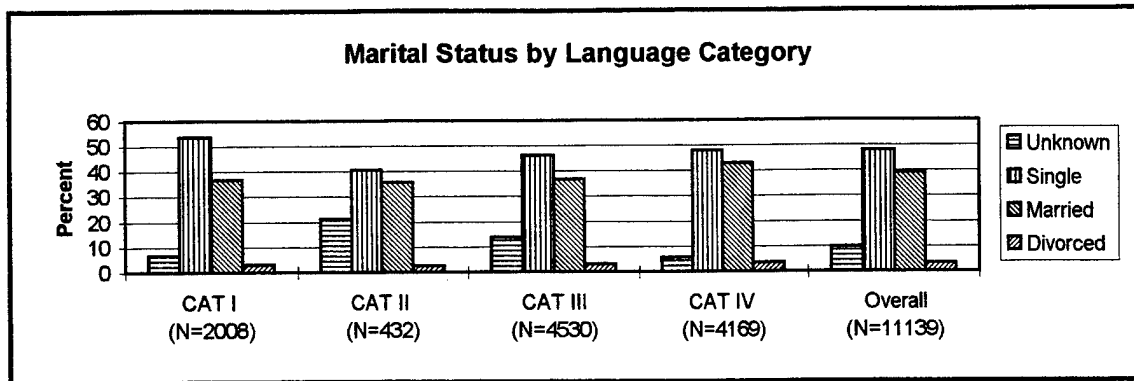
Marital Status by Language Category

Figure A. 18 Marital Status by Language Category.

The distribution of gender by service is displayed in Figure A.19. All of the services had a higher percentage of male students than female students; although the Marine Corps had significantly more male than female students. The Air Force had a closer proportion of male to female students than any other service. If gender were a predictor of attrition, one could expect greater academic attrition in the Marine Corps (due to the larger percentage of male students) and expect greater administrative attrition in the Air Force (due to the larger percentage of female students). (See page 23 for how attrition varies with gender.)
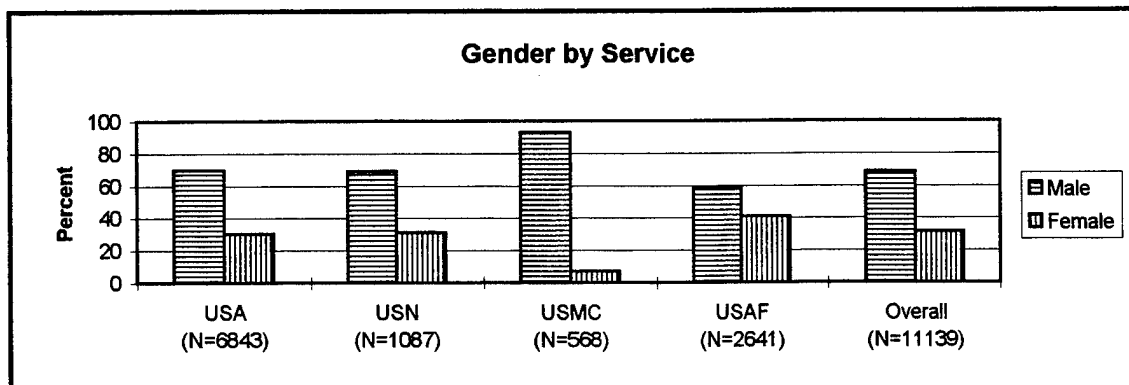
Gender by Service

Figure A. 19 Gender by service.

The distribution of gender by language category is displayed in Figure A.20. The ratio of male to female students was virtually constant across the four language categories. Therefore, there can be no conclusions concerning attrition from the distribution of gender in the language categories.
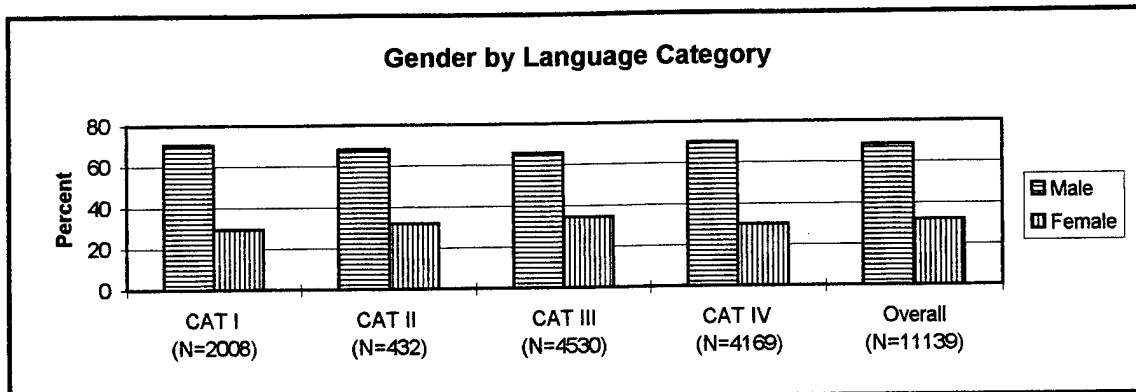
Figure A. 20 Gender by language category.

Race by service is displayed in Figure A.21. Since all services are predominately white, the white category was left off Figure A.21 so the other races could be better displayed.
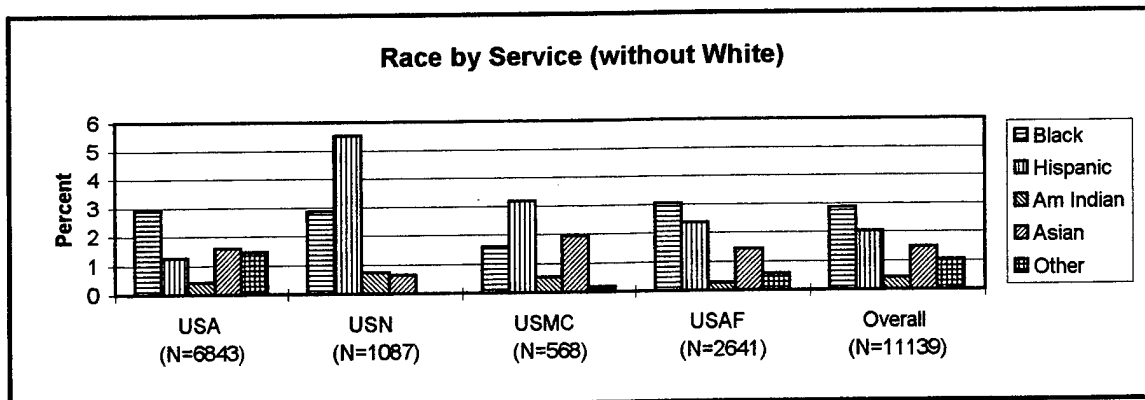

Figure A. 21 Race by service (without White).

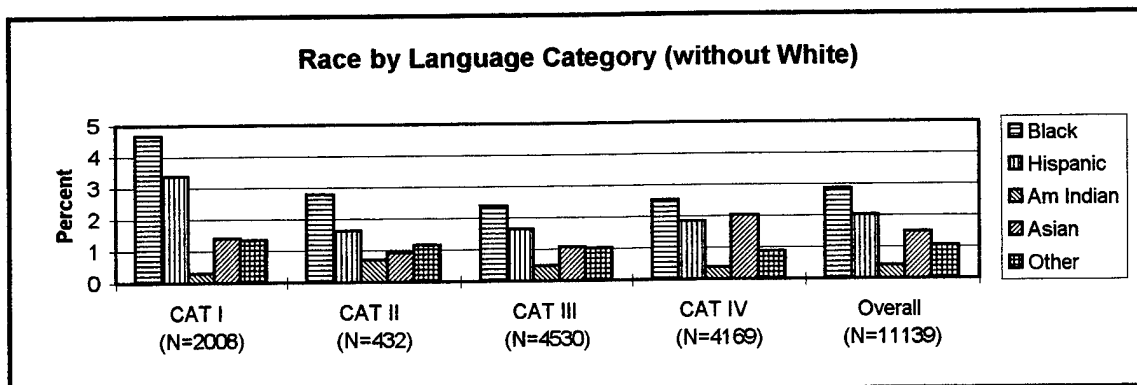Figure A.22 shows race when divided into Language Categories.

Figure A. 22 Race by Language Category (without White).

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Figure A.23 displays the self-evaluated motivation by service. The level of motivation was determined by the answer to a statement concerning language choice. The options are: 1-Not my choice. I would prefer to do something else rather than study a foreign language; 2-Not my choice. I am not motivated to study the assigned language; 3-Not my choice, but I am still motivated to study the assigned language; 4-Based on my second or third choice; 5-Based on my first choice. The Navy had over 60 percent of their students saying the language they were studying was based on their first choice. The Army had the most respondents with "not my choice, but I am still motivated to study the assigned language." If all other factors were constant, one might conclude the Navy would have less attrition than the other services since they may have been more satisfied with their course of study.
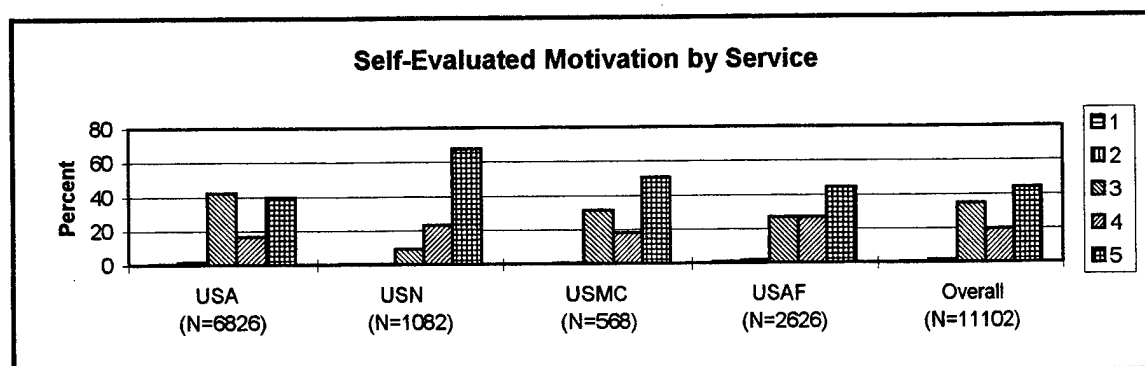

Figure A. 23 Self-evaluated motivation by service.

The self-evaluated motivation by language category is displayed in Figure A.24. Category IV languages were the only ones with less than 40 percent of the students saying their language of study was their first choice. Also Category IV languages were the only languages for which more than 40 percent of the students responded with "not my choice, but I am still motivated to study the assigned language." One might conclude that Category IV students would attrit more if attrition were due to self-evaluated motivation only.
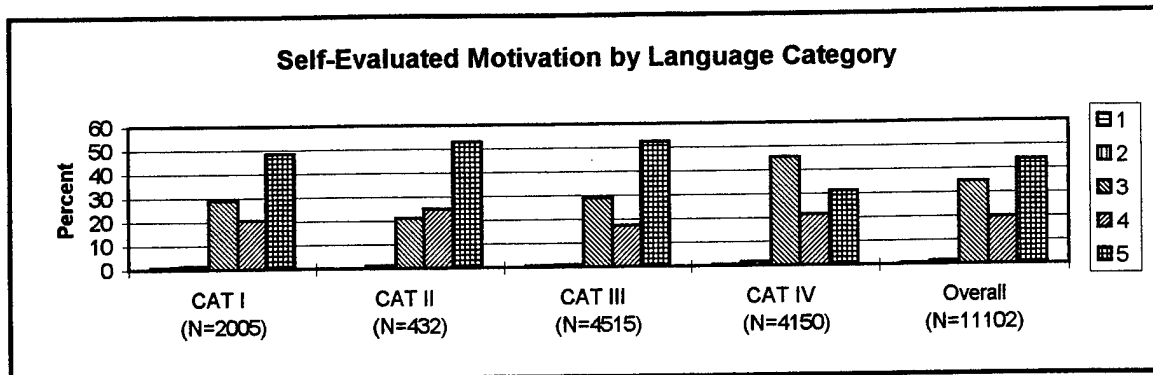
Figure A. 24 Self-evaluated motivation by language category.

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